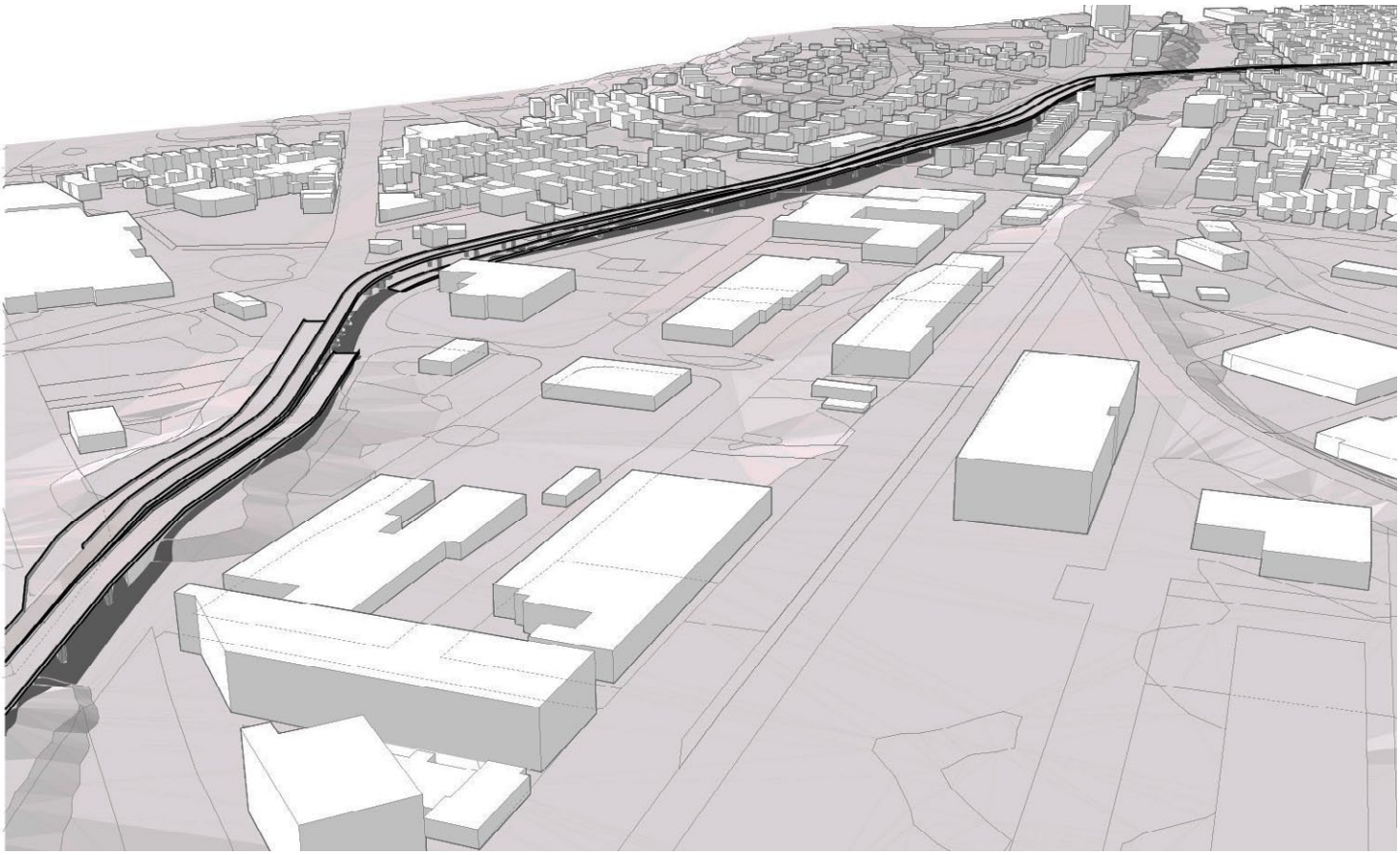

Grounding McGrath:
Determining the Future of the Route 28 Corridor
Final Report

Grounding McGrath Report | December 2013

massDOT | **McMahon Associates** | Nelson\Nygaard | Regina Villa Associates | GLC | HDR Engineering | Utile, Inc

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EXECUTIVE SUMMARY

Introduction

The infrastructure of the McGrath corridor (Route 28 from Mystic Avenue/Interstate 93- to the Cambridge city line) is antiquated. Some of the structures that carry traffic through the corridor are physically deteriorated, and the corridor's configuration represents an outdated approach to road building that emphasizes auto mobility without due consideration for either community impacts or access by other transportation modes.

Built in the early 1950's, the McGrath corridor's viaduct structures pre-date not only the Big Dig, but also the original construction of the Interstate 93 elevated viaduct through Somerville and Cambridge. This study is titled "Grounding McGrath" in recognition of the figurative need to "ground" the McGrath corridor in the reality of today's uses and community vision for the future, as well as the literal plan to bring the main elevated structure to grade level.

MassDOT initiated the Grounding McGrath – Determining the Future of the Route 28 Corridor Study (Grounding McGrath) in order to address a number of issues and objectives, including:

- Two of the five structures comprising the McGrath corridor study area – the McCarthy Viaduct and Gilman Street Bridge – were identified for repairs or replacement under MassDOT's Accelerated Bridge Program (ABP).
- The City of Somerville has continually expressed interest in removing the McCarthy Viaduct, and has undertaken a planning effort for the Inner Belt and Brickbottom Districts.
- The extension of the MBTA Green Line (GLX) to Somerville and Medford, which has entered the design/construction stage, will significantly enhance public transit access and capacity to the corridor.
- MassDOT's policies – including the GreenDOT Policy, the Mode Shift Goal, the Healthy Transportation Policy Directive, and the Complete Streets design approach – call for promoting healthy, multi-modal transportation choice. These policies strongly support the surrounding neighborhood's desire to improve multi-modal transportation in the McGrath corridor, including the planning and design for the Somerville Community Path.
- MassDOT must consider not only construction costs, but also long-term maintenance costs of elevated structures, and is re-evaluating whether it is necessary or appropriate to rebuild certain deteriorating overpasses throughout the Commonwealth.

This study is about not only improving transportation infrastructure, but also community connectivity, accessibility in all transportation modes, economic development, and addressing safety deficiencies. The Grounding McGrath effort goes well beyond a technical challenge, as it requires a multi-faceted approach to invite community engagement and evaluate potential strategies in order to achieve a broad range of desired outcomes.

The result of the Grounding McGrath study is a series of recommendations that are informed by the full range of corridor priorities, consistent with comprehensive data analysis, and supported by MassDOT, the Federal Highway Administration, corridor stakeholders, and the community as a whole. This report documents the process that has been undertaken, including civic engagement, establishment of goals and metrics, data collection and analysis, alternatives development and analysis, and recommendations. The recommendations of this study are grouped into short-, medium- and long-term improvements, along with an outline of the steps that will be necessary and the parties responsible for advancing these improvements through the project development process to implementation.

The study process builds on and integrates the work of the MassDOT project team, within the context of community input and other ongoing efforts. All steps were completed in consultation with the Working Group (see below), and results have been presented to the general public at advertised public informational meetings.

Study Area

The study area for the Grounding McGrath study is the Route 28 corridor from Broadway in Somerville in the north to Land Boulevard in Cambridge in the south (see Figure ES- 1). It comprises McGrath Highway and Monsignor O'Brien Highway. McGrath Highway runs from the junction with Mystic Avenue/Interstate 93 to the north (beyond which Route 28 is named the Fellsway) to the municipal boundary with Cambridge to the south. Route 28 is Monsignor O'Brien Highway through Cambridge to the municipal boundary with Boston. For purposes of this study, the entire length of Route 28 within the study area is generally referred to as the "McGrath corridor." Figure ES- 2 shows the study area, while Figure ES- 3 shows the central portion of the corridor (focus area) from an oblique angle to better represent the varying elevated structures.

The bridges and other structures that carry the McGrath corridor, as shown in Figure ES- 4, are the "Gilman Street Bridge," which carries the McGrath corridor over Gilman Street in Somerville; the Lowell Line Bridge, which carries McGrath over the MBTA Lowell Commuter Rail Line; the "McCarthy Viaduct" that carries McGrath over Washington Street and extends to carry McGrath southbound over the Medford Street/Somerville Avenue intersection; and the "Squire's Bridge", which carries Route 28 over the MBTA Fitchburg Commuter Rail Line.

Working Group

MassDOT's work on this project has been supplemented by a project Working Group, whose members include elected officials, state agencies, local advocacy groups, municipal officials, planning organizations and architects. Members represented and reported back to their constituencies and provided input on the process and the work of the project team. The Working Group met seven times throughout the project, providing feedback and guidance on the study's process, concepts, analysis and recommendations:

- June 29, 2011
- August 3, 2011
- December 12, 2011
- March 7, 2012
- September 27, 2012
- February 13, 2013
- April 25, 2013

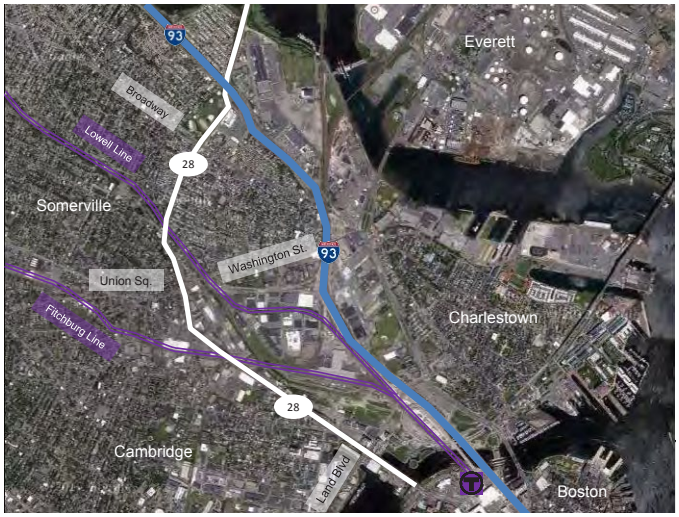


Figure ES-1: Route 28

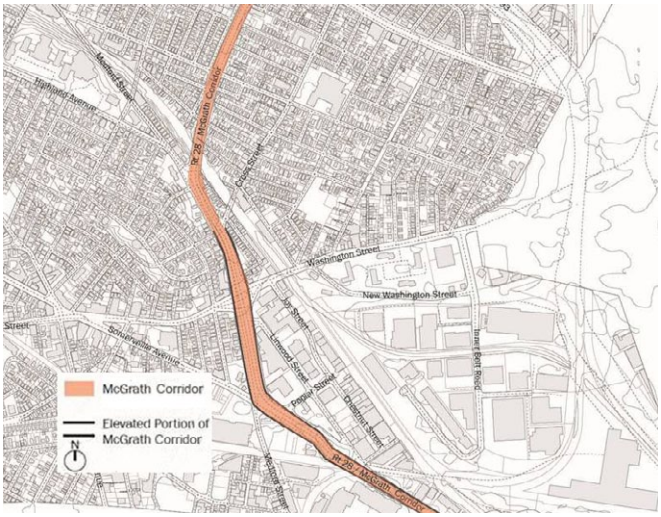


Figure ES-2: Study Area

Study Approach and Goals

The following defined Goals and Objectives were developed as part of the public involvement process:

1. Improve Access and Mobility
   Move people efficiently by all modes along and across the corridor, on all local and regional desire lines
   - » Improve regional and local travel time
   - » Improve health of residents
   - » Facilitate multi-modal transportation opportunities

2. Promote Connectivity
   Improve the cohesion of abutting neighborhoods for the sake of community, place-making and economic development
   - » Identify new connections
   - » Improve urban form/places
   - » Improve access to open space
   - » Support and/or generate economic development

3. Improve and Balance Functionality
   Ensure cost-effective and efficient use of many modes
   - » Enhance safety for all modes
   - » Maintain regional travel capacity
   - » Limit impacts on surrounding roadways

4. Provide Accountability
   Advance a design that is sensitive to the needs and desires of stakeholders
   - » Share benefits and burdens of changes
   - » Limit impact to environment
   - » Ensure long-term corridor maintainability

These goals and objectives are measured through the use of related evaluation criteria, which are discussed in more detail in Chapter 5.

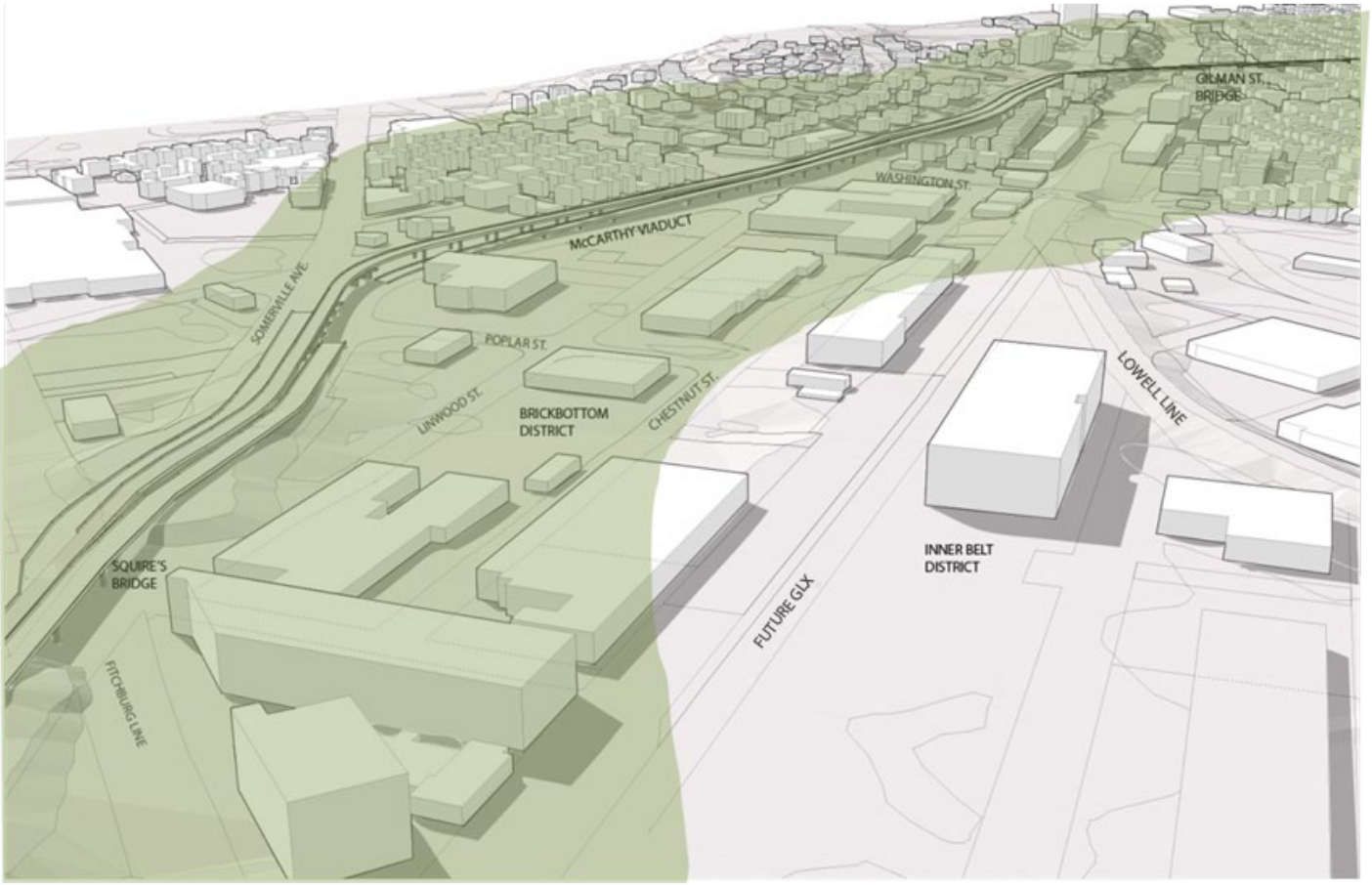


Figure ES-3: Focus Area

Existing Conditions and Key Issues

The study began with a thorough examination of existing conditions, including transportation conditions in all modes, land use, and economic development issues. Through the interdisciplinary Existing Conditions analysis, the Grounding McGrath study identified the critical issues and opportunities that drove the development of alternatives, and form the quantitative and qualitative basis upon which to measure the alternatives to the Goals and Objectives. The issues and opportunities presented below represent a distilled version of the larger trends, immediate needs, overall constraints and/or driving forces that were accounted for in the alternatives development and analysis tasks.

Structures

- Two structures on the McGrath corridor are currently slated for or are undergoing repair and/or rehabilitation.
  - » The Gilman Street Bridge is being replaced under MassDOT's Accelerated Bridge Program (ABP). This replacement is currently under design.
  - » The McCarthy Viaduct is currently undergoing a short-term repair and rehabilitation project to address pressing structural and safety issues. The scope of this project has been minimized in recognition of the decision to ultimately dismantle the structure, but it is a substantial project nonetheless due to the scale of the structure and the nature of the problems. MassDOT is also undertaking interim improvements to multi-modal access and safety in and across the McGrath corridor as part of the viaduct repair project.

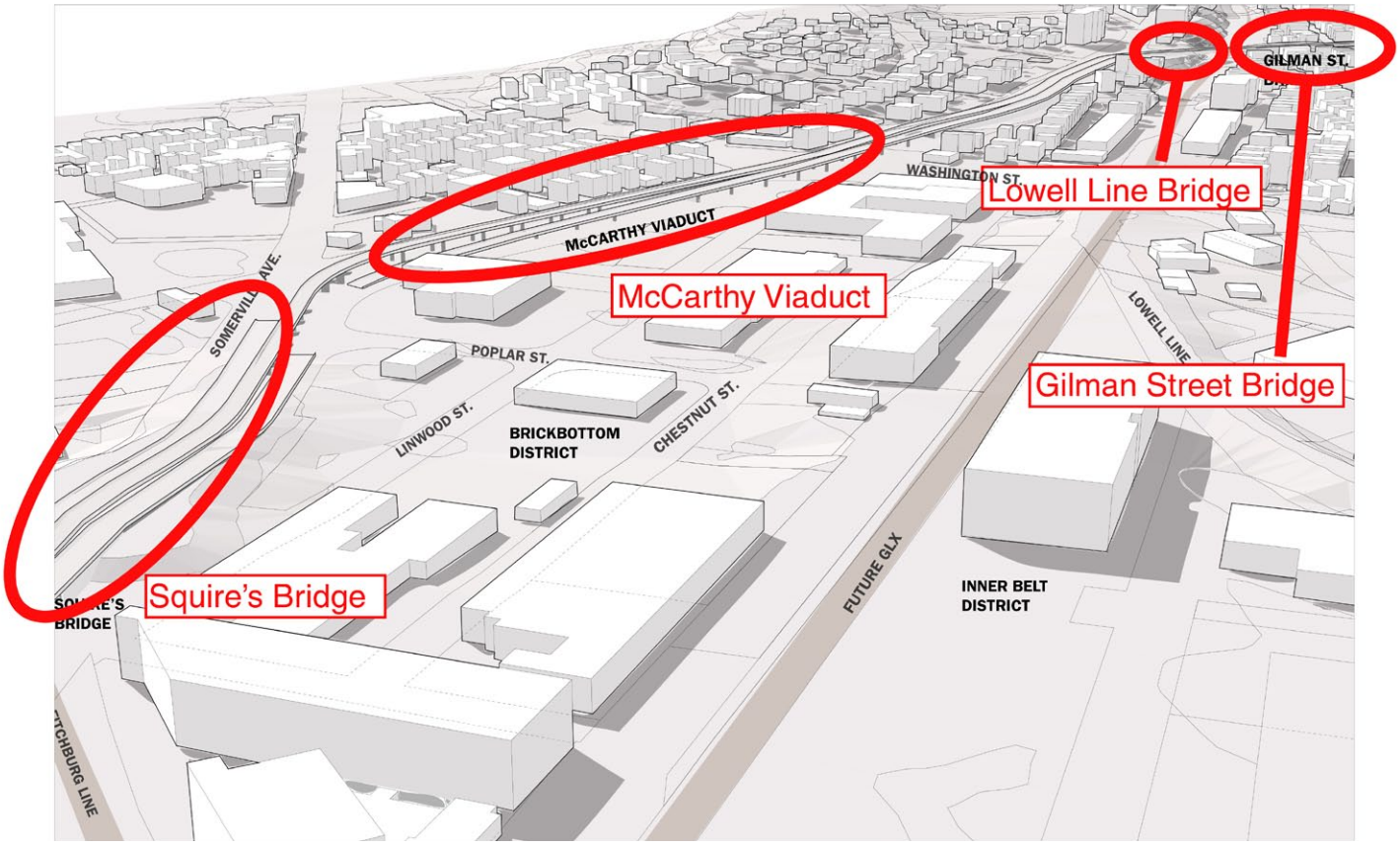


Figure ES-4: Bridges and Structures of Route 28

- The three structures not slated for repair (the Squire's Bridge, the Lowell Line Bridge, and the Otis Street pedestrian bridge) have condition ratings of Fair or Satisfactory. These three structures have isolated areas with deterioration, but do not currently require any repairs in the short-term.
- Due to clearance requirements by the MBTA, there are two ""fixed points" in the study area: (1) the truss bridge over the Lowell Line and (2) the Squire's Bridge over the MBTA Fitchburg Commuter Rail Line. Grade separation of roadway and railroad must be maintained in order to avoid creation of a new railroad grade crossing, and the clearance provided at these locations cannot be reduced.
- Roadway design standards for maximum roadway gradient limit the distance required to bring the McGrath corridor to grade from these two fixed points. This distance will be dependent on the design speed for the road, and whether pedestrian routes along McGrath will follow the traffic alignment.
- Changes to the McGrath corridor provide opportunity to improve the cost-effectiveness of infrastructure. The McGrath corridor is carried by approximately 1,500 feet of bridge structures and 258 feet of tunnel. The cost of maintaining these structures is a significant factor for the corridor.
  - » This is exacerbated by the age of these bridges. They are decades old and have structural elements that increase corrosion rates. Deck joints, which expose steel beams to water and de-icing salts, are one example.
  - » New structures would be required to carry the McGrath corridor from the fixed points to grade in the study focus area. New construction technologies available today could reduce future maintenance costs for these structures.

Pedestrians and Bicyclists

- The Somerville Community Path is being planned and designed through this area as part of the GLX project.
- The existing McGrath corridor is a pedestrian barrier. There are few crosswalks provided across the McGrath corridor, with an average of over ¼ mile between crossings. Even where pedestrian crossings exist, they are difficult, confusing, long, and uninviting.
- A high volume of pedestrians cross the McGrath corridor at the existing crosswalks, showing very strong pedestrian desire lines, including connections to and from the bus stop on Washington Street under the McCarthy Viaduct.
- Bicycling is allowed on the McGrath corridor, including on the elevated portions. However, this may be unclear to bicyclists, there are no bicycle lanes, and motor vehicle traffic is high volume and high speed. As a result, bicycle volumes are comparatively low.

Transit

- The MBTA's Green Line serves the southeastern corner of the study area, with Lechmere as the current end of the line. Lechmere Station also functions as a bus hub for routes 69, 80, 87 and 88.
- The planned GLX through the McGrath corridor will greatly enhance transit access and capacity in the corridor. This may provide an opportunity for mode shift to transit, decreased local traffic demand, and enhanced economic development.
- Two MBTA commuter rail lines (Fitchburg and Lowell) from North Station pass through the corridor, but do not have station stops in Somerville. While the lines do not service Somerville, the elevated roadway structures over the rail lines are necessary.
- Eleven MBTA bus routes operate in, across, or around the McGrath corridor, including routes CT2, 69, 80, 86, 87,88, 89, 90, 91, 95, and 101. These are primarily east-west routes, providing an opportunity to improve coordination of fixed route service and headways with the planning for the McGrath corridor.
- There are no bus routes that provide a consistent and complete connection along the McGrath corridor from Broadway to the MBTA Lechmere Station.
- There are no bus routes that use the McCarthy Viaduct. Buses use the surface streets to the extent possible, and must use the Squire's Bridge and the bridge over the Lowell Line.
- Union Square and the adjacent corridor neighborhoods all have direct bus service, but the Inner Belt and Brickbottom areas are only served on their periphery, along Washington Street and the McGrath corridor.

- Bus stops on the routes that bisect the corridor (Broadway, Washington Street) are close to the McGrath corridor and have challenging pedestrian crossings.
- Bus routes CT2, 80, 86, 87, 88, and 91 travel along portions of the McGrath corridor and could be affected by the project. Daily boardings in the corridor are approximately 1,315 passenger trips; total daily boardings on these routes are 17,428 passenger trips.

Demographics and Land Use

- The study area population of 56,560 grew by 3.6 percent from 1990-2010, while the population in Somerville decreased by one percent during the same period. The population in the study area is undergoing an increase in ethnic diversity, as well as an overall decrease in average age, with the percentage of children and elderly shrinking.
- Housing and commercial prices in the corridor vary widely, but have high points which represent levels at which redevelopment of existing properties and in some places, new construction can be supported.
- High housing demand and increasing home prices, in Somerville in general and in the McGrath corridor may also support significant redevelopment and some new construction.
- The area has seen more development interest based on the pending GLX project. Decisions about neighborhood character are important, and should be supported by plans for the McGrath corridor.

Environmental

- There are approximately fifteen small parks, playgrounds, and recreation areas along the McGrath corridor or in the immediate study area. Connections to these areas should be enhanced through the McGrath alternatives.
- During significant storm events, the Millers River and storm sewers in the area can flood lower portions of the study area, especially near the Somerville Avenue and Poplar Street intersections with the McGrath corridor.
- There are no DEP designated wetlands in the study area.
- Planning for the McGrath corridor should consider historically significant areas and neighborhoods, including the Prospect Hill area in Somerville and the Union Railway Car Barn in Cambridge, as well as three National Register Districts: East Cambridge, Winter Street, and Charles River Basin.
- There are a few DEP oil or hazardous materials sites with Activity and Use Limitation (AUL) along the corridor or immediately adjacent to the McGrath corridor:
  - » Opposite Foss Park
  - » Across the highway from Rufo Road
  - » To the east of Water Street
- In addition, there are several sites in the immediate study area in the Brickbottom and Inner Belt areas, south of the Fitchburg Commuter Rail Line and opposite Foss Park.
- Residents of neighborhoods abutting the McGrath corridor, like neighborhoods adjacent to other congested high-volume roadways, are at higher risk for respiratory diseases and other health risks due to the vehicle-related emissions from heavy traffic volumes than are residents of other neighborhoods.
- The presence of the elevated structure influences how noise pollution from traffic affects the adjacent neighborhood.

Vehicular Traffic

- There is an imbalanced directional split in vehicular traffic volumes: Typically, the peak period in the morning mirrors the afternoon reverse movement. However, southbound volumes are 12 percent higher on the McCarthy Viaduct and 19 percent higher on Monsignor O'Brien Highway in Cambridge in the AM peak than are the northbound volumes in the PM peak. This indicates that drivers may seek alternative routes in the PM.
- There are more than 900 vehicles that use Medford Street southbound (at Somerville Avenue) during the morning peak period. This serves as an alternative access point from the McGrath corridor to reach points in East Cambridge.
- Traffic volumes in the McGrath corridor are highest between Washington Street and Medford/Highland Avenue.
- There are substantial volumes (more than 1,000 vehicles during peak periods) on major cross streets

with the McGrath corridor, such as Broadway, Medford Street/Highland Avenue, Washington Street, Somerville Avenue/Medford Street, Third Street, and Land Boulevard. With the exception of Washington Street, these intersections are already at-grade. Some at-grade intersections with the McGrath corridor that experience long queues and high delay during peak periods include:

  - » Broadway: This intersection operates at LOS D during the morning peak period, and degrades to LOS E in the evening peak with long queues and high delays for the northbound and southbound left-turn movements.
  - » Medford/Highland: During the morning peak period, this intersection has a high volume of eastbound traffic turning right and a high volume of southbound through volumes that result in vehicle delay and an overall LOS F.
  - » Land Boulevard: During both the morning and evening peak periods, this intersection experiences long queues and high delay, particularly northbound left turns, southbound left-turns, and westbound movements.

- The elevated sections of the McGrath corridor over east-west cross-streets generally experience free-flow conditions for the mainline of the McGrath corridor, while the surface roads below experience some delay. The queues from the Washington Street intersection spill back onto the mainline of the McGrath corridor, which causes further delay. This situation is complicated by driver confusion regarding appropriate use of lanes in the vicinity of Washington Street under the McCarthy Viaduct.

- Based on the CTPS License Plate Survey, only 10 percent of vehicles observed in the AM period use the McGrath corridor segment from the Otis Street pedestrian bridge to the Museum of Science. About 39 percent of vehicles observed exited at Washington Street, indicating the McGrath corridor is used more for access to and from destinations in Somerville and Cambridge than as a through route to Boston. This pattern is expected to continue because the highest percentage of population and employment growth predicted in the corridor is in the focus area adjacent to future development of the Inner Belt/Brickbottom area, as well as Cambridge destinations such as Kendall Square and NorthPoint.
- Approximately 17 percent of the reported crashes from 2006-2008 involved pedestrians or cyclists (according to the Somerville Police Department).

Future Year Projections

The study also looked at the expected changes in population and other demographic characteristics between 2011 and 2035 and how those changes will impact transportation in the McGrath corridor. The purpose of this analysis is to evaluate transportation issues that are expected to arise in the McGrath corridor and to establish a baseline against which to compare proposed alternatives.

Conditions in the study area have been forecasted to the horizon year of 2035, consistent with the Boston Metropolitan Planning Organization (MPO)'s Regional Transportation Plan (RTP) and the regional travel demand model managed by the Central Transportation Planning Staff (CTPS). The CTPS regional travel demand model is used to understand peak period travel demand under the existing conditions, a future "No Build" condition in the horizon year of 2035, and also for the various alternatives in the future horizon year.

The No Build analysis establishes a future baseline against which to compare proposed alternatives. In addition to the existing conditions analysis, the following key issues and opportunities from the No Build informed the development of the alternatives:

- Population and employment growth in the Inner Belt/Brickbottom area of Somerville is expected to more than double from 2009 to 2035. This growth is expected to have a significant impact on the trips projected to and from that area in the form of new transit, automobile, and non-motorized (bicycle and pedestrian) trips.

- The regional travel demand model assumes planned transit projects such as the GLX and Assembly Square Orange Line Station are in place. As a result, there is projected to be an increase in transit mode share in the corridor for the future year of 2035 of approximately 5 percent in the AM peak

period, and about 3 percent increase in transit share in the PM peak period.

- Based on the outputs from the regional travel demand model, automobile trips along the McGrath corridor are expected to increase in the range of 7.5 percent to 12.5 percent between 2011 and 2035, depending on the segment of the corridor.

- There are some improvements in level of service (LOS) for intersections in 2035 compared to existing conditions. This is primarily due to assumed optimization of traffic signals in 2035. Intersections with the McGrath corridor projected to improve in overall LOS include:

  - » Broadway (PM peak)
  - » Cambridge Street/East Street (AM peak)
  - » Land Boulevard/Austin Street (AM and PM peak)

- Intersections with the McGrath corridor projected to experience a worsening in overall LOS include:

  - » Broadway (AM peak)
  - » Pearl Street (AM peak)
  - » Medford Street/Highland Avenue (PM peak)
  - » Somerville Avenue/Medford Street (PM peak)

Alternatives Development

Based on the existing conditions analysis, the key issues, and input from the Working Group, the Grounding McGrath project team initiated the alternatives development process. This process began with a broad range of high-level, conceptual approaches to the ultimate configuration of the corridor, organized into four general ”families” of alternatives:

Keep It:	No Build with structural improvements required for comparison (Future No-Build Conditions)
Move It:	Change the alignment of the McGrath corridor
Bring It Down:	At-grade roadway
Partial Grounding:	A combination of Keep It and Bring It Down options

It was the strongly-held position among members of the Working Group and the surrounding community that only the “Bring It Down” options could fully accomplish the overall goals of the study. In consultation with the Working Group, the community, and the City of Somerville, MassDOT concurred with this position, and the project team advanced the alternatives development process with an exclusive focus on grounded alternatives.

The “Bring It Down” conceptual approach was developed into more specific alternatives focusing on the following configurations:

- Signalized Rotaries
- Median U-turns
- Access Roads
- Boulevard

These four surface roadway concepts were refined into three alternatives for analysis using the regional travel demand model, and for thorough evaluation relative to the criteria developed for Grounding McGrath.

Alternatives Analysis

1. The **Boulevard Alternative** (see Figure ES- 5) features general purpose lanes, three in each direction, on the McGrath corridor between Medford Street to the north and Poplar Street to the south. Left-turns are prohibited from McGrath at Washington Street, both northbound and southbound; these connections can be satisfied at the McGrath Highway/Somerville Avenue/Medford Street/Poplar Street intersection. Poplar Street is realigned slightly north of its current location.

2. The **Hybrid U-Turn/Rotary Alternative** (see Figure ES- 6) combines two initial alternatives and features a rotary at the McGrath corridor/Somerville Avenue/ Medford Street/Poplar Street intersection, with the McGrath mainline passing through the rotary. Left-turns are prohibited from McGrath at Washington Street, both northbound and southbound; these connections can be satisfied at signalized U-turn intersections located north and south of Washington Street.

Figure ES-5: Boulevard Alternative

SECTION
A-A

Figure ES-6: U-Turn/Rotary Hybrid Alternative

SECTION A-A

Figure ES-7: Linwood Access Road Alternative

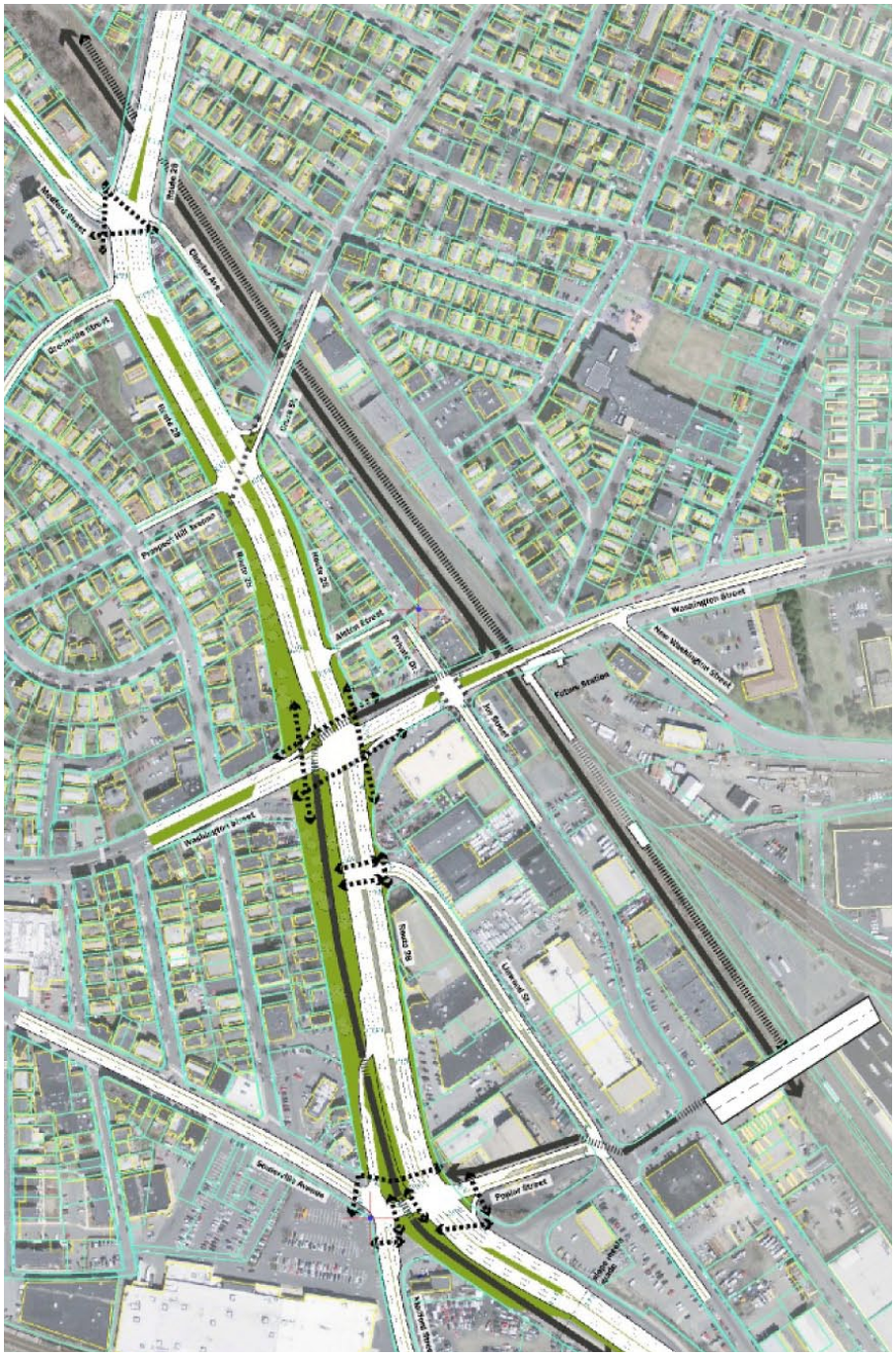


Figure ES-8: IBBB Alternative

3. The **Access Road Alternative** (see Figure ES- 7) features two lanes on the McGrath corridor in each direction for the major north/south travel, while cross street traffic is connected via a circulating access road (with signal control). The access roads allow two-lane access to/from the McGrath corridor/ Somerville Avenue/Medford Street/Poplar Street intersection. This alternative provides northbound access to Union Square via Linwood Street. Southbound access from Union Square is provided via Somerville Avenue.

4. A fourth alternative, which is essentially the **Boulevard Alternative** with a new roadway connection through **Inner Belt** (see Figure ES- 8), was developed by the City of Somerville through its Inner Belt/Brickbottom (IBBB) Study process. This alternative includes a multimodal bridge connection from Inner Belt across the Fitchburg Line tracks connecting through NorthPoint to the McGrath corridor in Cambridge. It also includes an extension of Poplar Street under the future GLX tracks to connect Brickbottom and Inner Belt. This fourth alternative was evaluated by CTPS as part of the IBBB Study, and the outputs were shared with the Grounding McGrath project team.

The at-grade connections achieved by these four alternatives provide an opportunity for a Complete Streets approach that allows for enhanced pedestrian connections, urban design improvements, and a reclaimed right-of-way for other uses. Specifically, the value and importance of a shared-use path that would serve both regional and local bicycling and walking connectivity was recognized. For this primary reason, a shared-use path through the focus area corridor, as well as connections to and from the path, was consistently maintained throughout the alternatives development and analysis processes.

Through collaboration with the study Working Group, MassDOT developed evaluation criteria and metrics for its analysis. The detailed Evaluation Matrix presented in Chapter 5 was prepared as a tool for comparing the developed alternatives and the No Build conditions. The Evaluation Matrix does not establish any preference or weighting of the importance of one objective to another. These preferences are part of the community and Working Group discussions. Through the use of the these metrics, all of the proposed scenarios -- Boulevard, Access Road, Hybrid U-turn/ Rotary and Boulevard & Inner Belt Road, and the 2035 No Build -- were quantitatively scored relative to the No Build alternative for the Future Year 2035 based on their ability to meet each of the set criteria.

As a result of the analysis, the study provides several broad conclusions:

- Build alternatives show an improvement over the No Build scenario for most categories of the evaluation criteria.
- Build alternatives have similarities in achieving the project's goals.
- Build alternatives have challenges and traffic implications.
- Build alternatives improve community character and provide environmental, public health and Environmental Justice benefits.
- Build alternatives provide new real estate development opportunities.
- Build alternatives have lower 75-year life-cycle costs for the focus area than the No Build alternative.

With the implementation of reduced capacity and the speed changes due to potential congestion for the modeled alternatives, the CTPS regional travel demand model indicated a significant reduction in volumes along the McGrath corridor for all alternatives. Assuming this reduction in traffic volumes and the attendant diversion of traffic (to other modes, other routes, or other travel time periods) is deemed acceptable, the implementation of a narrower north/south cross section appears to be feasible.

However, it should be noted that this feasibility is based on the assumption that a significant number of vehicles that currently travel along the McGrath corridor will not do so in the future. Many of the travelers that would have been in these vehicles are expected to shift to other modes or displace to other travel times, but other travelers would remain in motor vehicles and divert to other routes; the potential impact of those diverted trips should be considered by the affected communities. Additionally, vehicular movements that are currently grade separated with free-flow movement will be more

challenging to process at the new at-grade signals along the corridor due to the delay inherent in the operations of signalized intersections.

For each of the Build alternatives, the Grounding McGrath study identified traffic, operational, and other potential issues that have not been resolved. For example, further study of traffic diversion to other streets in the network, and the resulting capacity issues at other key intersections outside the study corridor, will be required.

Through the study's public outreach process, preference for the criteria related to livability, multimodal transportation, connectivity, community development, and placemaking were expressed, and were also given priority by Working Group members in evaluating their preference for a long-term alternative.

What is the Health Impact Assessment? (HIA)

Formed in 2009 as a provision of the Transportation Reform Legislation that created MassDOT, the Massachusetts Healthy Transportation Compact (HTC) is an inter-agency initiative designed to foster transportation decisions that balance the needs of all users, expand mobility, improve public health, support a cleaner environment and create stronger communities. The directives of the HTC include establishing methods to use Health Impact Assessments (HIAs) to determine the effects of transportation projects on public health and vulnerable populations, and providing transportation planners and engineers, public health administrators and developers with tools to assess public health issues in transportation. The Massachusetts Department of Public Health (MDPH) received a grant to conduct a pilot HIA of an active MassDOT transportation planning study. MassDOT worked closely with MDPH in the selection of the Grounding McGrath Study as a pilot HIA project.

On April 4, 2013, MDPH released the draft HIA for the Grounding McGrath study on its website for public comment. Based on the data reviewed for the HIA, MDPH concluded that all four study alternatives would provide public health benefits to the community. However, the Boulevard and the Inner Belt Alternatives were identified as offering the greatest opportunities for mobility and access in the corridor.

Recommendations and Next Steps

In the context of MassDOT's current policies and programs, including GreenDOT, which seeks to triple the travel mode share of non-automobile use; the Complete Streets approach to roadway design; and the Healthy Transportation Compact, MassDOT recommends moving forward with the Boulevard Alternative (see Figure ES- 9 and Figure ES- 10).

This alternative would provide the following benefits:

- Provide a Complete Streets design for the McGrath corridor by incorporating access for all modes and for users of a diverse range of ages and abilities.
- Improve traffic operations at seven of fifteen intersections compared to the No Build due to refined signal timing and reduced volumes.
- Reduce roadway width and congestion through management of circulation and turning movements.
- Improve multi-modal access to Union Square and Brickbottom via the McGrath corridor, Somerville Avenue, and Poplar Street.
- Provide at-grade intersections that are more intuitive for wayfinding.
- Create enhanced pedestrian access across the corridor.
- Allow the reclamation of the right-of-way for other uses.
- Provide for urban design and community character improvements.
- Provide an opportunity for compliance with the Americans with Disabilities Act of 1990 and the Massachusetts Architectural Access Board by being rigorously designed to current accessibility and mobility standards and regulations.

MassDOT and the project team presented this recommended alternative at a public meeting on May 15, 2013. Those in attendance were generally supportive of MassDOT's efforts to remove the existing barrier created by an elevated highway and incorporate transit and non-motorized modes of travel. However, many Working Group members and other attendees also voiced comments, concerns, and preferences regarding the preferred alternative. MassDOT recognizes these concerns, and takes this feedback from the Working Group and the community very seriously. The following are the principal issues raised about the preferred alternative, and responses to those issues:

Roadway Cross-Section

- Public Comments. A preference for further reduction of vehicular capacity, and an exploration of a Boulevard option with four travel lanes (two in each direction). Many participants expressed this preference, and it is the comment that would have the greatest effect on the overall design and function of the preferred alternative, and is discussed further below.
- MassDOT Response. It is understandable that the Grounding McGrath study participants favor an alternative that emphasizes minimizing local impacts. MassDOT, however, must also consider the impacts of the corridor design on roadway users in all modes. While MassDOT feels that the Six-Lane Boulevard Alternative was developed, refined, and analyzed as a design approach that appropriately balances regional mobility with multi-modal accessibility and neighborhood livability, MassDOT is willing to give consideration to a four-lane design for the McGrath corridor, as discussed further below. A four-lane design may result in reduced motor vehicle demand and volumes in the corridor; however, this would be due to increased congestion and delay, which would also be experienced by residents of neighborhoods abutting the corridor.

Functional Classification of the McGrath Corridor

- Public Comments. A preference for creating a more "livable community" by designing a local roadway, rather than an arterial.
- MassDOT Response. MassDOT strongly supports a McGrath corridor design that helps to create a livable community in the area, and multi-modal transportation corridors both along the McGrath corridor and Washington Street. Relative to the question of a local roadway versus an arterial roadway, these are technical "functional classes" of roadway. An arterial is a higher-volume roadway that is used largely for longer trips, while a local roadway is the "lowest" class of roadway, and is used principally for access to and from adjacent land uses. The McGrath corridor is currently a principal arterial, the "highest" class of roadway aside from interstate highways. It currently serves important regional connections for Medford, Somerville, Cambridge, and Boston, and MassDOT believes it should continue to do so, even in a lower-volume, lower-speed, and more neighborhood-friendly at-grade configuration.

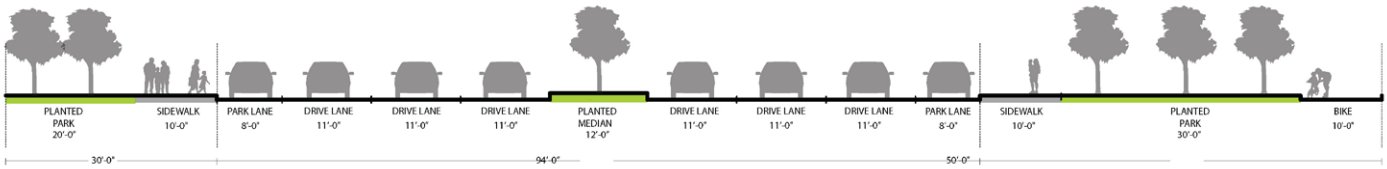
Multi-Modal Facility Design

- Public Comments. A desire for more clearly-defined pedestrian and bicycle facilities.
- MassDOT Response. Each Build alternative includes comprehensive and thorough consideration and accommodation of pedestrian and bicycle facilities. Such facilities are provided in the designs of all the Build alternatives. The designs of the Boulevard Alternative are appropriate for the purposes of a planning study, but they are still conceptual. The level of definition of accommodation for all modes is still fairly general, and will become more clearly defined as the corridor design advances through an open and public process.

Circulation and Turn Restrictions

- Public Comments. Concerns about the impact of circulation management and turn restrictions on local access.
- MassDOT Response. Turn lanes require widening a roadway. They also reduce operational efficiency by requiring the addition of more phases to a traffic signal cycle, which increases congestion. The preliminary concept for the Boulevard Alternative proposes the elimination of northbound and southbound left turns at Washington Street; these turning movements have relatively low volumes, and the connections that they provide can also be satisfied at adjacent intersections (via northbound left turns at Somerville Avenue and southbound left turns at Poplar Street). Including left turns from McGrath at Washington Street would also reduce the operational efficiency of the intersection and the corridor in a manner that would make a four-lane boulevard cross-section even more difficult to achieve. Even though these turn restrictions would make local access more circuitous for neighborhood residents, it is more likely to help achieve the goals of a narrower, more livable McGrath corridor.

Based on the study analysis and the feedback received at the May 15, 2013 public meeting, MassDOT recommends advancing the Six-Lane Boulevard Alternative into the environmental review process. MassDOT also recommends consideration of a Four-Lane Boulevard “Road Diet” sub-option that further reduces roadway scale. This sub-option would require additional analysis through the environmental process, comparable to what was completed for the six-lane option for the Grounding McGrath study.



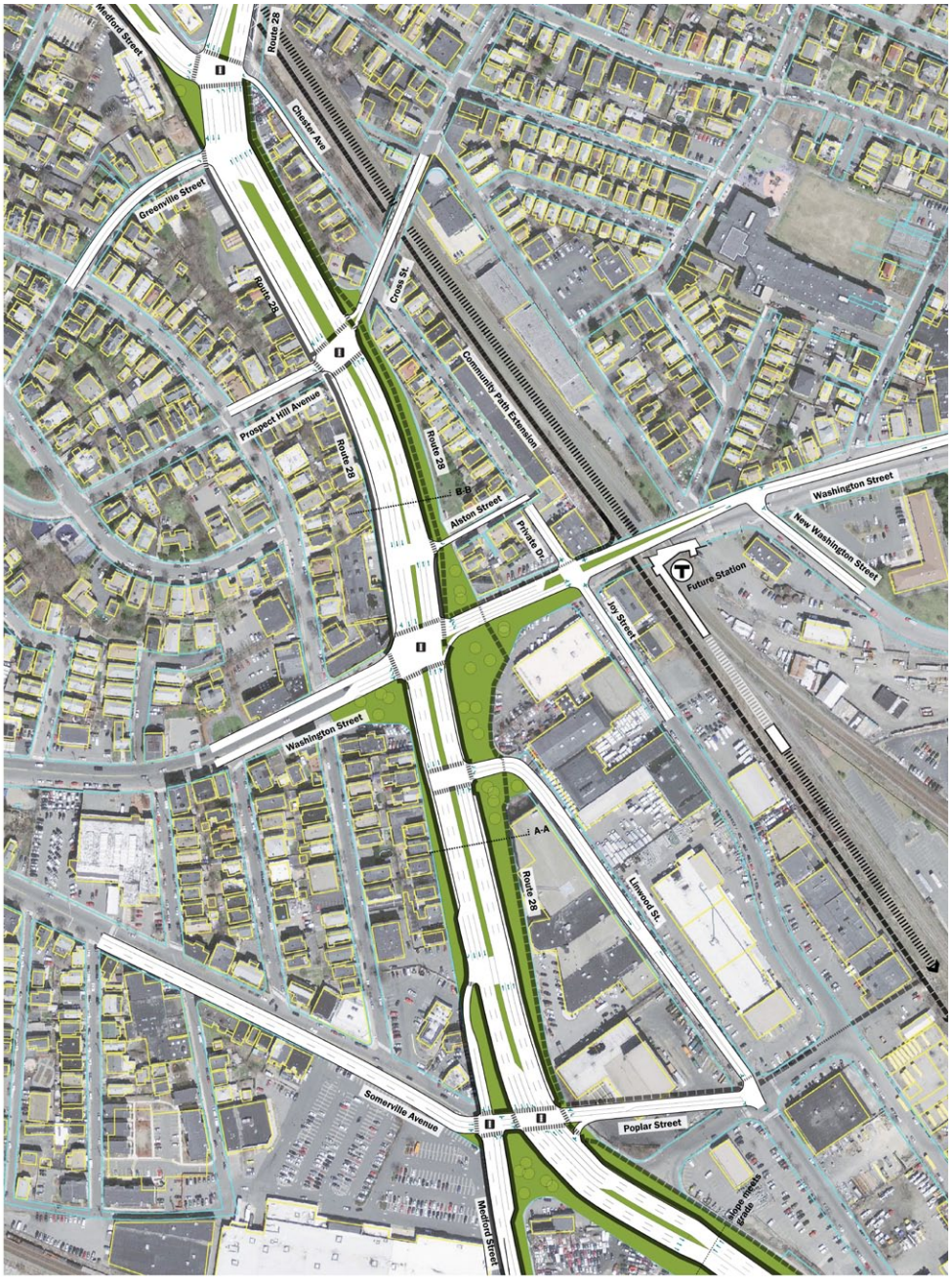
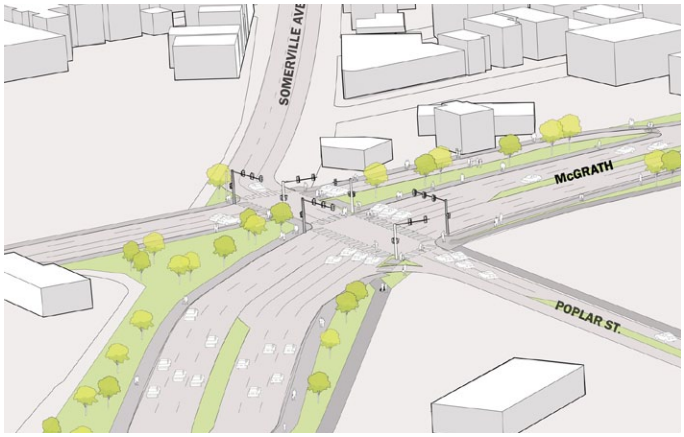
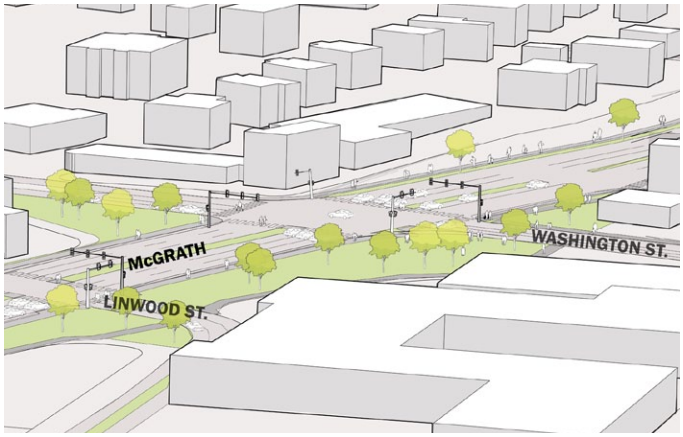


Figure ES-9: Boulevard Recommended Alternative

Somerville Avenue Intersection



Washington Street Intersection



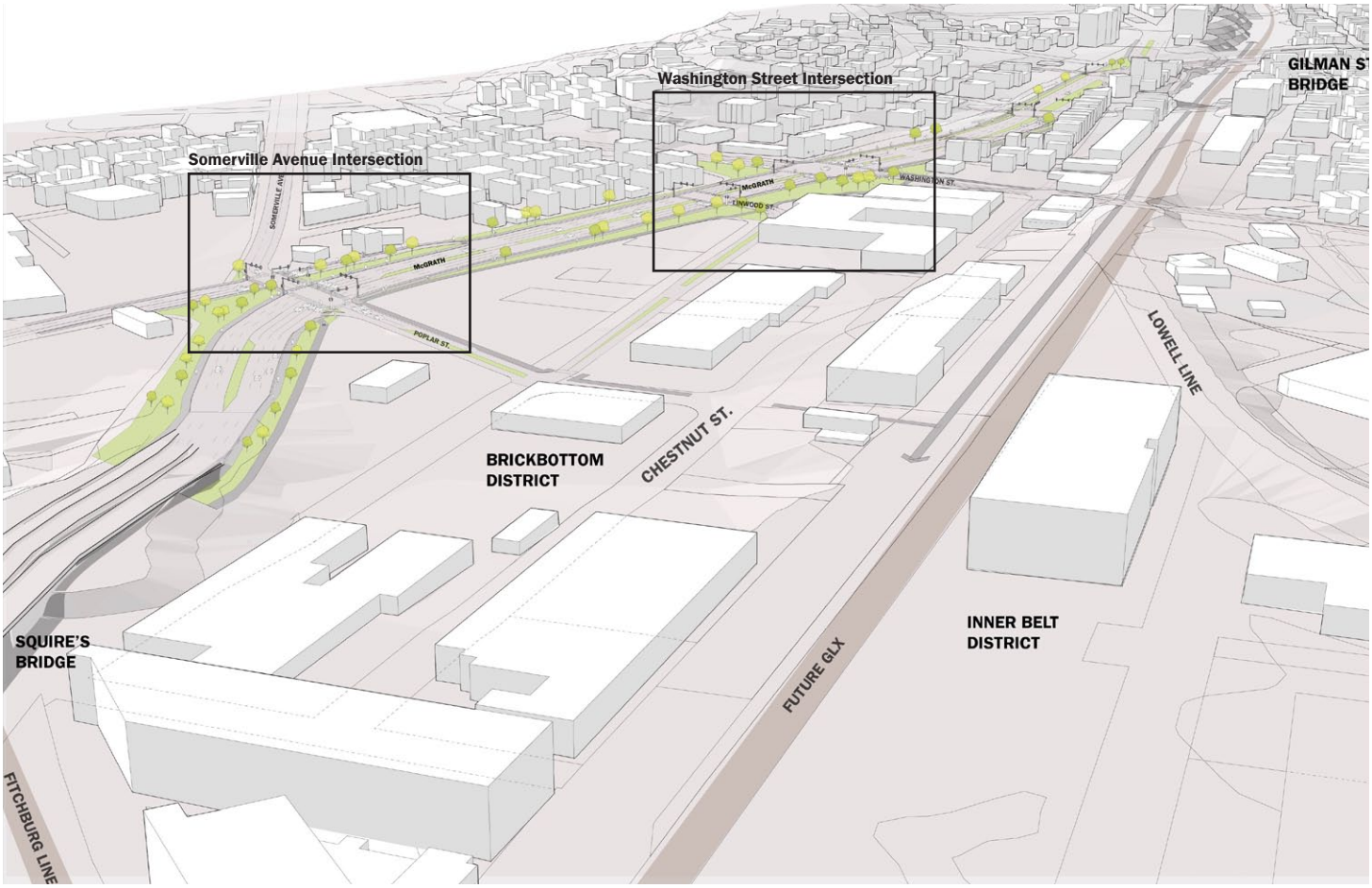


Figure ES-10: Boulevard Alternative Renderings

Recommended Long-Term Corridor Alternative – Implementation Plan

The following is a summary of the short-term, medium-term, and long-term steps to be taken in order to pursue implementation of the Boulevard Alternative for the McGrath corridor.

	Actions	Primary Responsibility	Supporting Responsibility
	Immediate Actions		
I1	Initiate the project development process by submitting Project Needs and Initiation Forms	City of Somerville	MassDOT
I2	Determine level of State and Federal environmental review and permitting necessary to proceed into project development	MassDOT	
I3	Work with the Boston Metropolitan Planning Organization (MPO) to include the project in the next update of the Regional Transportation Plan (RTP)	City of Somerville	
I4	Collect traffic, bicycle and pedestrian data and conduct analyses to assess circulation changes and opportunities resulting from the interim improvements proposed by MassDOT District 4 as part of the ongoing structural repair work	MassDOT	
	Medium-Term Actions		
M1	Conduct and complete environmental permitting and preliminary engineering process that should include, but not be limited to, the following:	MassDOT	City of Somerville, Stakeholders, General Public
	• Examination of the implications of traffic diversions that could occur on side streets, adjacent neighborhoods, and the regional roadway network including Rutherford Avenue		
	• Clarify and integrate plans for the Brickbottom, Inner Belt, and Union Square areas of Somerville and NorthPoint in Cambridge		
	• Continue coordination with the Green Line Extension (GLX) project to clarify improvements and ensure proper connectivity		MBTA
	• Ensure that accommodations for local bus route stops are considered and incorporated as part of the design options		MBTA

	Actions	Primary Responsibility	Supporting Responsibility
	• Develop potential design refinements at Washington Street based on potential for trip diversion with new IBBB connections (e.g. additional eastbound/westbound lanes; exclusive, channelized right-turn lanes) • Coordinate with Federal Highway Administration (FHWA) on implications of changing the McGrath corridor as part of the National Highway System (NHS) • Incorporate elements of the Health Impact Assessment recommendations • Ensure proper connections to Somerville Community Path to the north and south • Develop and integrate a corridor-management plan for curb cuts • Examine potential utility upgrades (e.g. underground, relocation, fiber optic, etc. • Select a preferred Boulevard Alternative design option	MassDOT	Stakeholders
M2	Implement an aggressive Travel Demand Management (TDM) program aimed at reducing single-occupant vehicular trips along the McGrath corridor as well as overall trips generated, particularly in areas targeted for future development.	City of Somerville	MassRIDES
	Long-Term		
L1	Complete engineering, design, and permitting	MassDOT	Stakeholders
L2	Coordinate with the Boston Metropolitan Planning Organization (MPO) to secure construction funding through the regional Transportation Improvement Program (TIP)	City of Somerville	Boston MPO

McGrath Corridor Interim Improvements

There are a number of short-term and medium-term recommendations related to physical improvements and policy implementation that should be pursued either independent of the long-term Boulevard Alternative, or else are important interim measures that should be put in place in advance of the Boulevard Alternative and Four-Lane sub-option. There are also a number of short-term and medium-term actions that should be taken in pursuit of the Boulevard Alternative through the environmental permitting, project development, and funding processes.

	Actions	Primary Responsibility	Supporting Responsibility
C1	Improved pedestrian crossings with new crosswalks, signage and signal timing at the following intersections with McGrath Highway • Medford Street/Highland Avenue • Washington Street • Medford Street/Somerville Avenue (west of the McGrath corridor) • Medford Street/Somerville Avenue/Poplar Street (east of the McGrath corridor)	MassDOT	City of Somerville, Stakeholders
U1	Complete McCarthy Viaduct Interim Repairs	MassDOT	City of Somerville, Stakeholders
U2	Continue to Advance Design of Somerville Avenue 'Punch-Through' to McGrath Highway Northbound, and McGrath Southbound Off-Ramp to Somerville Avenue Closure	MassDOT	City of Somerville, Stakeholders
I1	Improve the roadway cross-section, north of the Lowell Line bridge, by adding on-street parking and/or bicycle facilities (Complete Streets approach) • Examine removal of the Otis Street pedestrian bridge		
I2	Explore the feasibility of changes in lane configurations at the intersection of Highland Avenue/Medford Street at the McGrath corridor	MassDOT	City of Somerville, Stakeholders
I3	Promote safe routes of travel for pedestrians and bicycles within the McGrath corridor, such as providing a "best routes" map	City of Somerville	Stakeholders

CHAPTER 1: OVERVIEW

Introduction

The McGrath corridor (Route 28 from Mystic Avenue/ Interstate 93- to the Cambridge city line) is antiquated– some of the structures that carry the corridor are physically deteriorated and the corridor represents an outdated approach to road building that emphasizes auto mobility without due consideration for either community impacts or access by other transportation modes. Built in the early 1950's, it pre-dates not only the Big Dig, but the Interstate 93 northbound elevated viaduct. This study is titled "Grounding McGrath" in recognition of the figurative need to "ground" the McGrath corridor in the reality of today's uses and community vision for the future, as well as the literal plan to bring the main elevated structure to grade level.

The Massachusetts Department of Transportation (MassDOT) has only recently taken control of the McGrath Highway/Route 28 corridor. As part of the 2009 Massachusetts transportation reform legislation,[1] ownership of the roadway and structures was transferred from the Massachusetts Department of Conservation and Recreation (DCR) to MassDOT. Two of the structures

1 MassDOT website, "In June 2009, Governor Deval Patrick signed Chapter 25 of the Acts of 2009, "An Act Modernizing the Transportation Systems of the Commonwealth of Massachusetts, (as amended by Chapter 26 of the "Act.") This landmark transportation reform legislation requires that the Commonwealth integrate transportation agencies and authorities into a new, streamlined Massachusetts Department of Transportation (MassDOT) to be established by November 1, 2009."

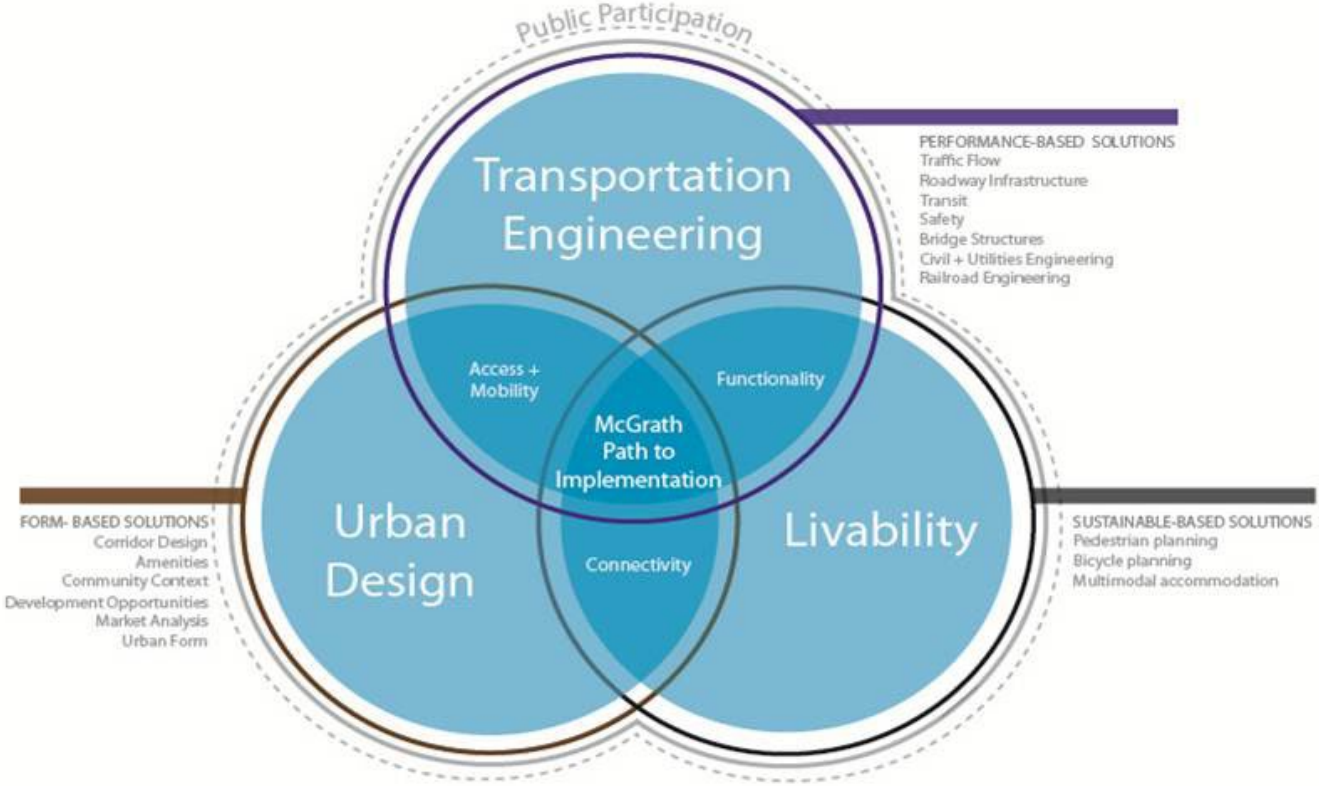


Figure 1-1: Pathway to Implementation Diagram

that comprise the elevated portions and bridges of the McGrath corridor (Gilman Street Bridge and McCarthy Viaduct) were quickly identified for upgrades under MassDOT's Accelerated Bridge Program (ABP), which seeks to repair, rehabilitate, or rebuild structurally or functionally deficient bridge structures throughout the Commonwealth.

MassDOT recognized the longstanding desire on the part of the surrounding communities to revisit the need for the corridor's elevated structures and the potentially transformative nature of the redesign of the McGrath corridor. Thus, MassDOT initiated this study – Grounding McGrath: Determining the Future of the Route 28 Corridor Study (Grounding McGrath) – which is about not only improving transportation infrastructure, but also community connectivity, accessibility across all transportation modes, economic development, and addressing safety deficiencies. The Grounding McGrath effort goes well beyond a technical challenge, as it requires a multi-faceted approach to invite community engagement and evaluate potential strategies in order to achieve a broad range of desired outcomes (see Figure 1-1).

Study Purpose

Grounding McGrath examines the potential removal of portions of the elevated roadway within the City of Somerville, while striving to enhance access for all modes of travel. The study is intended to assess the premise that removing all or a portion of the highway structure can create a unified corridor, rather than a barrier separating Somerville neighborhoods. New transportation opportunities, provided by the completion of the Central Artery/Tunnel project (i.e., The Big Dig), and planned transit and community pathway improvements, will continue to change the way people travel within and through the corridor, at the same time that the deteriorated condition of the elevated structures requires that something be done to make improvements in the corridor.

The Grounding McGrath effort seeks to not only balance the needs of transportation uses, but to facilitate connections along the corridor, and encourage development that will have a positive impact on the surrounding neighborhoods and the region as a whole.

The size of the investment necessary to establish a long-term fix for the elevated structure(s) indicates that now is the time to look at potential de-elevation of the McCarthy Viaduct, the longest segment structure in the McGrath corridor study area that carries traffic over Washington Street. Moreover, there are a number of ongoing processes and persistent issues that require a broader evaluation of the overall McGrath corridor, including:

- Two of the five structures comprising the McGrath Corridor study area – the McCarthy Viaduct and Gilman Street Bridge – were identified for repairs or replacement under MassDOT's Accelerated Bridge Program (ABP).
- The City of Somerville has continually expressed interest in removing the McCarthy Viaduct, and has undertaken a planning effort for the Inner Belt and Brickbottom Districts.
- The extension of the MBTA Green Line to Somerville and Medford, which has entered the design/ construction stage, will significantly enhance public transit access and capacity to the corridor.
- MassDOT's policies – including the GreenDOT Policy, the Mode Shift Goal, the Healthy Transportation Policy Directive, and the Complete Streets design approach – call for promoting healthy, multi-modal transportation choice. These policies strongly support the surrounding neighborhood's desire to improve multi-modal transportation in the McGrath corridor, including the planning and design for the Somerville Community Path.
- MassDOT must consider not only construction costs, but also long-term maintenance costs of elevated structures, and is re-evaluating whether it is necessary or appropriate to rebuild certain deteriorating overpasses throughout the Commonwealth.

Ultimately, the purpose of the Grounding McGrath study is to establish a series of recommendations that are informed by the full range of corridor priorities, consistent with comprehensive data analysis, and supported by MassDOT, the Federal Highway Administration (FHWA), corridor stakeholders, and the community as a whole. This report documents the process that has been undertaken, including civic engagement, establishment of goals and metrics, data collection and analysis, alternatives development and analysis, and recommendations. The product of this study will

be short, medium and long-term recommendations for improvements within the study area, along with an outline of the next steps that will be necessary and the parties responsible for moving these improvements forward into the project development process.

Goals and Objectives

MassDOT, the Working Group and the project team identified key goals and objectives for the Grounding McGrath: Determining the Future of Route 28 Corridor Study as part of an extensive public outreach and engagement process. The goals and objectives provided a means for the study to not only evaluate the alternatives, but to determine if the study is achieving its intended purpose.

The goals were based on community priorities, state and regional planning principles, MassDOTpolicies, City of Somerville plans and priorities, and general transportation planning principles and practice. The goals were also informed by funding constraints, environmental issues, and the findings of parallel efforts such as the HIA and IBBB Study (discussed below). Each of these four goals was a driving principle behind the project, and for each goal the project team identified a wide array of objectives by which the McGrath alternatives were evaluated. The breadth of the objectives was meant to capture the broad implications of the Grounding McGrath Study among different user groups and geographies. These goals and objectives are as follows:

1. Improve Access and Mobility
   Move people efficiently by all modes along and across the corridor, on all local and regional desire lines
   - » Improve regional and local travel time
   - » Improve health of residents
   - » Facilitate multi-modal transportation opportunities

2. Promote Connectivity
   Improve the cohesion of abutting neighborhoods for the sake of community, place-making and economic development
   - » Identify new connections
   - » Improve urban form/places
   - » Improve access to open space
   - » Support and/or generate economic development

3. Improve and Balance Functionality
   Ensure cost-effective and efficient use of many modes
   - » Enhance safety for all modes
   - » Maintain regional travel capacity
   - » Limit impacts on surrounding roadways

4. Provide Accountability
   Advance a design that is sensitive to the needs and desires of stakeholders
   - » Share benefits and burdens of changes
   - » Limit impact to environment
   - » Ensure long-term corridor maintainability

The objectives were translated into quantifiable measures, which allowed the project team to compare alternatives on a wide variety of scales as objectively as possible. This multi-faceted approach identified specific differences between alternatives, in an effort to more closely align corridor designs and decisions to community goals.

Study Process

The Grounding McGrath study was conducted by MassDOT's Office of Transportation Planning (MassDOT Planning), and assisted by an interdisciplinary project team with the Boston-based firms of McMahon Associates and Nelson\Nygaard in the lead. A Working Group was organized by MassDOT, and served to help the project team evaluate opportunities for the future of the McGrath corridor in Somerville and Cambridge, provide input on the study tasks, report back to their respective groups, and overall to guide the study process.

The study process builds on and integrates the work of the MassDOT project team, within the context of community input and other ongoing efforts. The report is organized in the same manner as the study process, which followed a series of steps executed sequentially to ultimately develop recommendations that match the defined goals and objectives. These steps are summarized below, and also represent the chapters of this document:

Overview:
Present study framework and process, establish the goals and objectives, more clearly define the study area, develop evaluation criteria to be used in the assessment of the alternatives, and develop a Public Involvement Plan that would ensure a robust and transparent public study process.

Existing Conditions and Issues Evaluation:
Establish existing conditions in the study area. Conditions include multimodal transportation analysis, land use, demographics, environmental conditions and other factors as needed. A summary of study area issues and opportunities highlights the particular challenges within each category.

Future Year Projections:
Develop a forecast future year of 2035, consistent with the Boston Metropolitan Planning Organization (MPO)'s Regional Transportation Plan (RTP) and the regional travel demand model managed by the Central Transportation Planning Staff (CTPS). The 2035 future condition without any improvements or changes associated with this study – or Future No-Build condition –assumes that the McGrath corridor functions much as it does today. The Future No-Build condition assumes that no alternatives (including any potential change to the elevated structures or lane configurations) are to be implemented within the McGrath corridor, but accounts for the expected changes in population and employment and the implementation of other transportation projects in the region.

Alternatives Development:
A wide range of alternative design scenarios are proposed to address the challenges that have been identified in the study area. These options are then discussed through a community engagement process and put through a screening process to eliminate infeasible options, combine desirable elements from different alternatives, and narrow down the range of options. The final alternatives are then developed to the level that they can be measured using the established evaluation criteria.

Alternatives Analysis:
In this step, detailed evaluation of the alternatives is conducted and results are measured relative to the evaluation criteria. Alternatives are evaluated in a future "horizon" year (2035). The alternatives analysis includes the No-Build alternative as a baseline for comparison.

Recommendations:
Based on the analysis of alternatives, a series of recommendations are proposed for short, medium and long range implementation. This section also identifies the issues associated with implementation, and steps along the way toward an improved McGrath corridor.

All these study phases were completed in consultation with the Working Group, and results have been presented to the general public at advertised public informational meetings. Additional details on the public participation process are included in this chapter, within the public outreach section.

Study Area

The study area for the Grounding McGrath study is the Route 28 corridor from Broadway in Somerville in the north to Land Boulevard in Cambridge in the south (see Figure 1-2). It comprises McGrath Highway and Monsignor O'Brien Highway. McGrath Highway runs from the junction with Mystic Avenue/Interstate 93 to the north (beyond which Route 28 is named the Fellsway) to the municipal boundary with Cambridge to the south. Route 28 is Monsignor O'Brien Highway through Cambridge to the municipal boundary with Boston. For purposes of this study, the entire length of Route 28 within the study area is generally referred to as the "McGrath corridor." Figure 1 -3 shows the study area, while Figure 1-4 shows the central portion of the corridor (focus area) from an oblique angle to better represent the varying elevated structures that are the principal focus of the study alternatives and analysis.

The study process and approach for Grounding McGrath was to evaluate the corridor as a whole, while investigating both regional impacts and design solutions that may vary on a block-by-block basis. Balancing the desires of a future for the study area that supports community development objectives, with the associated larger transportation, mobility, environmental and public health goals was the ongoing and primary challenge of this effort. Thus, even though the feasibility and cost estimates for either retaining or removing the elevated

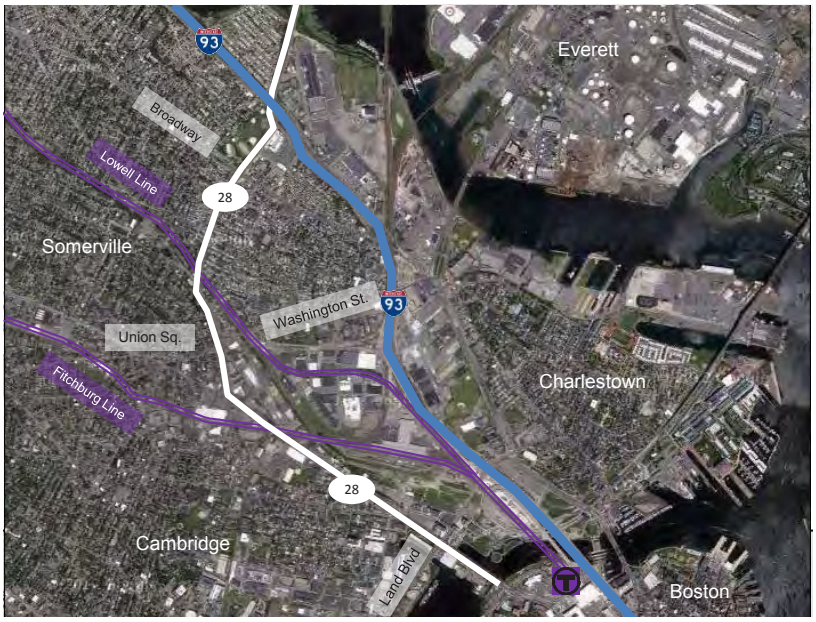


Figure 1-2: Route 28

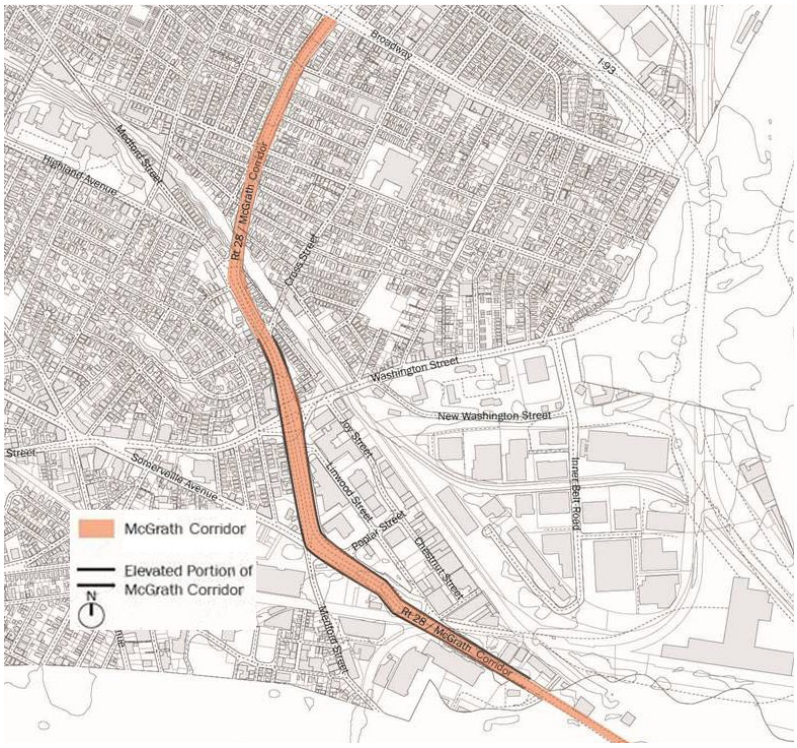


Figure 1-3: Study Area

Figure 1-4: Focus Area

portions of the McGrath corridor focus on the roadway itself, the benefits and impacts are analyzed over a broader area. Mobility for all modes of travel on both a local and regional level were considered, including the impacts on cross streets.

Background

The McGrath corridor predates the Interstate 93 northbound elevated viaduct and for many years was the primary route from points north to and from Boston, Cambridge, and Somerville. With a combination of elevated structures, at-grade roadways, and bridges over active rail lines, the corridor currently includes a combination of complex intersections, bypasses, and challenging crossings. Along with adjacent industrial areas and rail lines, McGrath's elevated structures for motorists have long severed neighborhoods of Somerville and Cambridge from each other.

The bridges and other structures that carry the McGrath corridor also have specific names, as shown in Figure 1-5. From north to south, the first is the "Gilman Street Bridge," which carries the McGrath corridor over Gilman Street in Somerville. Immediately south of the Gilman Street Bridge is the Lowell Line Bridge, which carries the McGrath corridor over the MBTA Lowell Commuter Rail Line. The McGrath corridor is at grade at the intersection with Medford Street/Somerville Avenue. The next structure is the "McCarthy Viaduct," a viaduct that carries the McGrath corridor over Washington Street and extends to carry McGrath southbound over the Medford Street/Somerville Avenue intersection. The final structure is the "Squire's Bridge", which carries the McGrath corridor over the MBTA Fitchburg Commuter

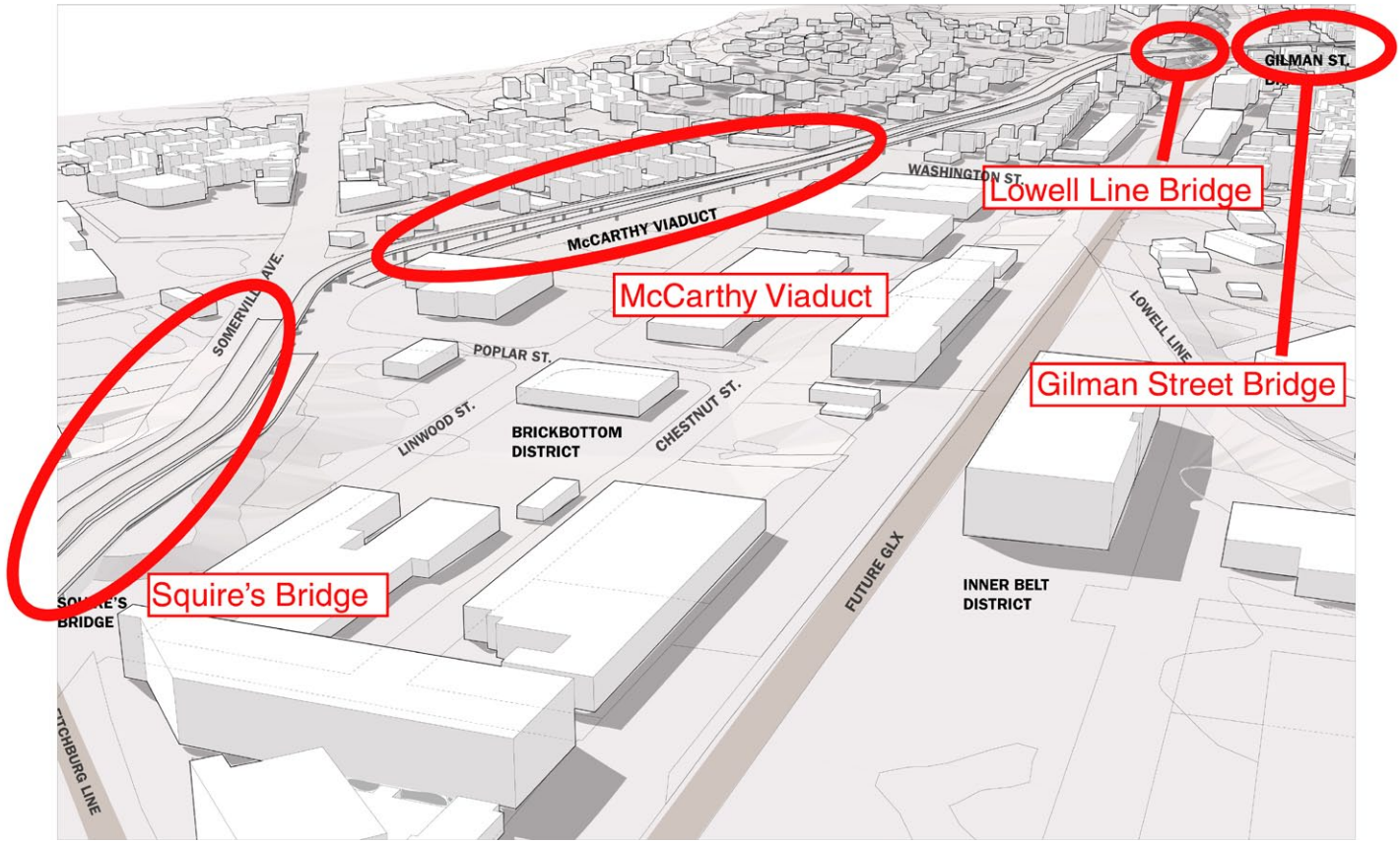


Figure 1-5: Bridges and Structures of Route 28

Rail Line. Since both the roadway and the structures have specific names, it is possible to use both names in referring to the same segment (e.g. the McCarthy Viaduct carries the McGrath corridor over Washington Street).

Massachusetts State Route 28 within the study area is functionally classified by MassDOT as an "other freeway." Route 28 is also classified as "Other NHS Route" within the National Highway System (NHS) by the Federal Highway Administration.[2] The NHS funded roadway network in Massachusetts represents all Interstates, most of the principal arterial system, and a small portion of the urban collectors.[3] Proposed modifications to the NHS must meet criteria and enhance characteristics of the NHS, and be implemented in cooperation with local and regional officials.[4]

Demographics

Changes are occurring rapidly on and along the McGrath corridor. The study area includes adjacent neighborhoods comprising 13 census tracts in Somerville and Cambridge (see Figure 1-6). In 2010, the population in this area was 56,560 residents, a 3.6 percent increase since 1990. The focus area of the elevated portions between the Lowell Line Bridge and Squire's Bridge – directly abuts four census tracts in Somerville. In the focus area, the population was 14,860, which has grown even more rapidly -- at a 4.1 percent rate between 1990

2 http://services.massdot.state.ma.us/maptemplate/roadinventory

3 Road Inventory Year-End Report, MassDOT Office of Transportation Planning, 2010

4 Federal-Aid Policy Guide, December 19, 1997, Appendix D, Section 103(b) of title 23, U.S.C

Route 28 Corridor for Demographic, Ecomonic Study

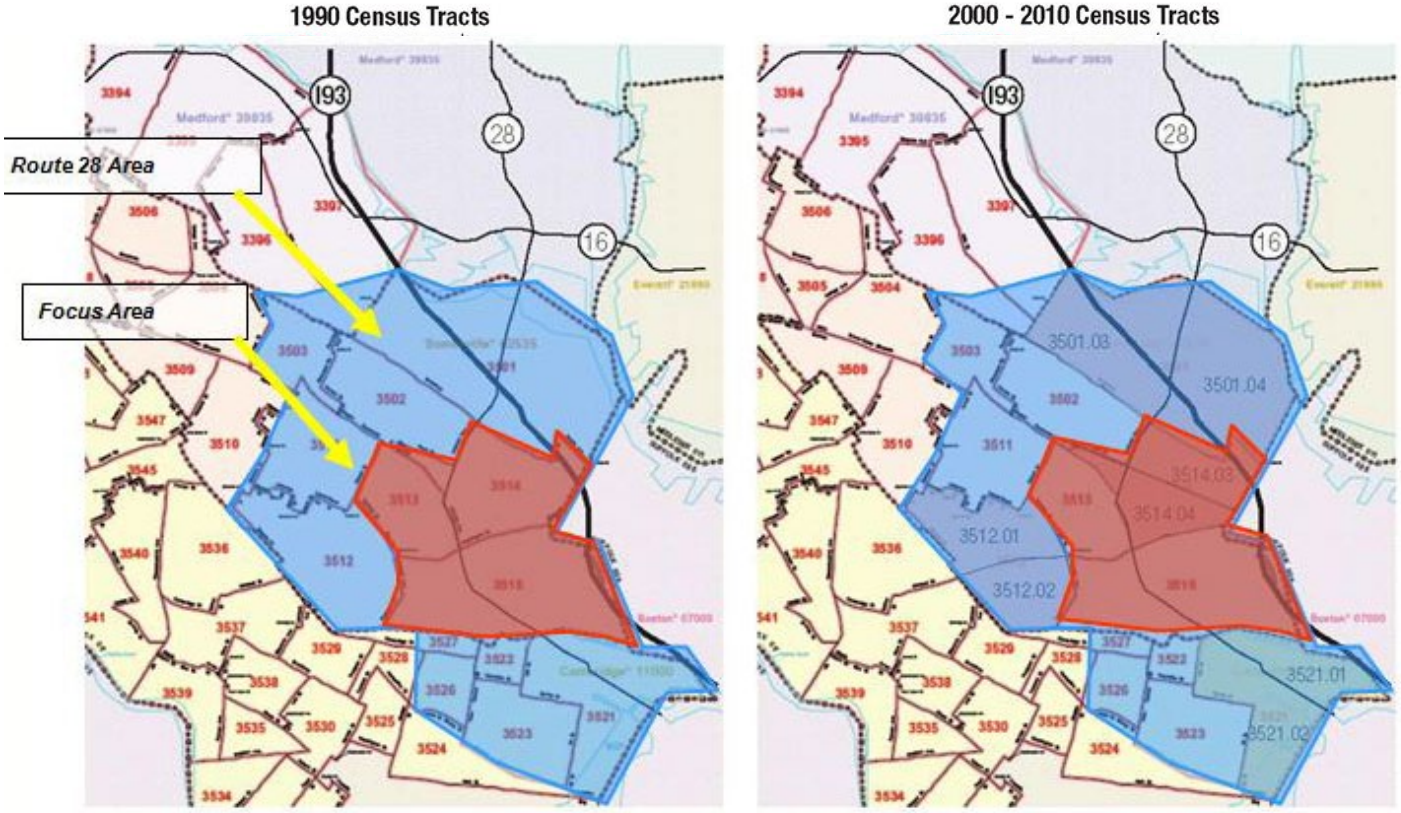


Figure 1-6: Census Tracts

and 2010 – than the overall study area. This increase is significant, especially compared with a 1 percent decrease in the overall Somerville population over that same period. Interestingly, this population is also diversifying rapidly in both the larger study area and the focus area. There has been significant growth in the population of Black, Asian and Hispanic residents. The White population has declined over the last 20 years, from 88 percent of residents to 64 percent, while the Hispanic population grew to 13.9 percent from 2 percent over that period.[5]

While many of the large industrial employers have moved from the corridor, the area still retains its industrial character and there is still a robust employment base within the study area. In this same area, there are over 23,000 employees, working in over 1,300 establishments. Eighty percent of these businesses employ less than 50 people. The largest concentration of employees, 31 percent, is in the Finance, Insurance and Real Estate Sector. In total, businesses in the study area represent almost $1 billion ($983 million) in payroll in 2010.

MassDOT Policy Support

MassDOT policies are consistent with and strongly support the aims of the Grounding McGrath study to provide a balanced transportation system that supports transportation access in all modes, as well healthy, vital neighborhoods. These supporting policies include:

- The GreenDOT Policy, MassDOT's comprehensive sustainability initiative that is designed to integrate environmental responsibility into all MassDOT functions. GreenDOT is driven by three primary goals: reduce greenhouse gas emissions; promote the healthy transportation options of walking, bicycling, and public transit; and support smart growth development.
- Complete Streets, the comprehensive multi-modal design philosophy in MassDOT's Project Development and Design Guide. Complete Streets calls for safe and appropriate accommodation of all roadway users, and an approach to roadway design that works "from the outside in," giving critical early consideration not only to motor vehicles, but also pedestrians, bicyclists, and public transit riders.
- The Healthy Transportation Compact, an inter-agency group established by the 2009 Transportation Reform Law that established MassDOT, which includes MassDOT, the Executive Office of Health and Human Services, and the Executive Office of Energy and Environmental Affairs. The Healthy Transportation Compact, which is discussed in more detail below, is designed to promote healthy lifestyles through transportation system design and operations that facilitate walking, bicycling, and other active transportation modes.
- The Healthy Transportation Policy Directive, which builds upon MassDOT's Complete Streets guidelines, GreenDOT Policy, and Healthy Transportation Compact by requiring that all MassDOT projects not only accommodate, but actively promote healthy transportation modes.
- The Mode Shift Goal, announced by MassDOT in October 2012, is an initiative to triple the share of travel by bicycling, transit and walking in Massachusetts by 2030. In collaboration with regional transportation partners, community leaders, advocates and customers, MassDOT will reconsider what is possible for the Commonwealth's transportation system and imagine healthier, greener and cleaner mobility. The Mode Shift Goal is featured in MassDOT's GreenDOT Implementation Plan.

Parallel Planning and Implementation Processes

The Grounding McGrath study incorporated the changing nature of the corridor into its analyses. All alternatives include land use and demographic projections into a future horizon year (2035). More importantly, the Working Group, City of Somerville, MassDOT and many stakeholders view this study and the potential transformation of the McGrath corridor as a critical element in realizing the potential of the area. Future analysis includes a series of changes and improvements across alternatives, including:

- Land use projections/changes;
- Transportation access improvements, in particular the Green Line Extension (GLX), with stations at Washington Street and in Union Square; and
- Demographic and population changes.

The Grounding McGrath study built upon and coordinated with the work of several parallel and previous efforts. These informed the existing and future

5 United States Census data

conditions evaluation, influenced the goals and measures developed, and worked in tandem with the alternatives developed. These processes included:

Toward a Route 28 Corridor Transportation Plan: An Emerging Vision, CTPS
Prior to the transfer of ownership of the McGrath corridor from DCR to MassDOT, the Central Transportation Planning Staff (CTPS) completed a preliminary evaluation titled "Toward a Route 28 Corridor Transportation Plan: An Emerging Vision," in December 2008. In many ways the Grounding McGrath study is a follow-up to the CTPS effort, which provided a conceptual plan for the Route 28 corridor in Somerville. The report provided an initial evaluation and developed general recommendations to guide current and future public investment and private development projects along the corridor, as defined by the Route 28 Corridor Advisory Committee.

Green Line Extension (GLX)
MassDOT and the Massachusetts Bay Transportation Authority (MBTA) are working jointly on this important project to extend the MBTA Green Line service from a relocated Lechmere Station in East Cambridge, to Union Square in Somerville and College Avenue in Medford. The GLX will bring greatly improved public transit service to densely populated areas of Cambridge and Somerville.

The GLX includes a new station at Washington Street, directly abutting the study area, as well as a station in Union Square. The Washington Street Station near Brickbottom, would be located just east of the McGrath corridor, at the corner of Washington Street. The station would be on the elevated railroad abutment and extend south from Washington Street towards Poplar Street. The City of Somerville is working closely with the MBTA on the specifics of the design, and a likely local bus connection on the Inner Belt (east) side of the station. The Washington Street Station would increase transit use in the area, and create additional pedestrian desire lines and crossings of the McGrath corridor.

Figure 1-7 shows the proposed alignment of the GLX.

Inner Belt/Brickbottom Study
The City of Somerville's Office of Strategic Planning and Community Development (OSPCD) has undertaken a major planning initiative for the area known as the Inner Belt and Brickbottom Districts, a 160-acre light industrial zone located in the southeast corner of Somerville, adjacent to McGrath Highway along its eastern edge. The goal of the redevelopment of Inner Belt/Brickbottom (IBBB) is to expand the land uses of the area and to improve and increase access to the Districts by reconnecting it to the rest of Somerville, as well as to Boston and Cambridge. The defined goals of the IBBB study are to:

- Create mixed use development;
- Enhance transit access;
- Rework/reconnect infrastructure;
- Strengthen the public realm by creating open space;
- Connect to a network of accessible districts; and
- Leverage life sciences and institutional convergence with neighboring university facilities.

The land use projections, transportation access issues, and future development of a Green Line station explored through the IBBB Study were incorporated in the Grounding McGrath study. Additionally, as the IBBB and Grounding McGrath studies are integrally linked and were conducted in parallel, much of the transportation data developed (including traffic analysis networks) for each was shared and coordinated. Regional travel modeling analysis, conducted by CTPS, was also shared, and the overall results and analysis were reported in a similar fashion. The IBBB Study also generated an additional modeled alternative that builds off the work completed in the Grounding McGrath study.

Somerville Community Path
The existing Somerville Community Path extends from Cedar Street to Grove Street in Davis Square, where it connects to the Linear Path, which in turn connects to the Alewife area in Cambridge and the Minuteman Bikeway rail trail. The extension of the Community Path through the McGrath corridor to Cambridge and beyond offers the opportunity to provide new connections for many Somerville residents, to connect the Minuteman Bikeway with the Paul Dudley White path network along the Charles River, and to enhance regional trail network connectivity. It is a high priority for both Somerville and

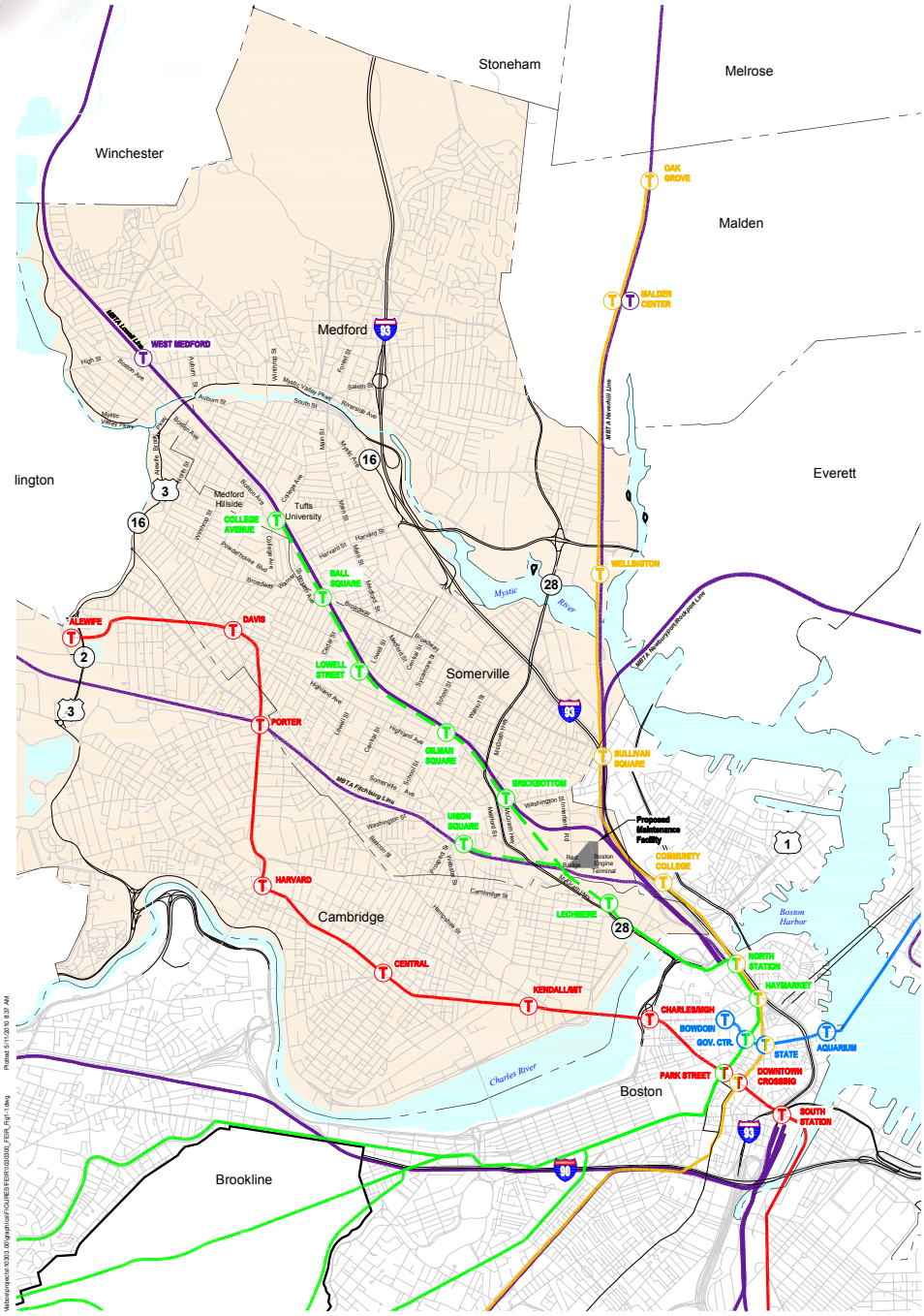


Figure 1-7: Green Line Extension

the region at large. The City of Somerville, the "Friends of the Community Path," and numerous other advocacy groups, have been working to provide an ultimate connection between the Minuteman Bikeway and the Charles River path networks.

MassDOT recognizes that the Community Path extension is a significant component in meeting the Commonwealth's commitments to enhancing non-auto mode share, as well as meeting health and environmental goals. Thus, current designs for the MBTA's planned GLX include a continuation of the Community Path along the GLX right-of-way south to Inner Belt Road, with associated connections to ground level at Washington Street and Poplar Street. Providing enhanced bicycle and pedestrian access from the surrounding neighborhood to the proposed Community Path extension was a primary feature of all developed alternatives for Grounding McGrath.

Additional Projects

Within the project study area, there are a number of infrastructure projects and adjacent development districts already being studied, as shown in Figure 1 -8.

Health Impact Assessment

At the Project's initiation, the Grounding McGrath study was selected by the Commonwealth to be a pilot project on which to conduct a Health Impact Assessment (HIA). An HIA is a process through which the anticipated

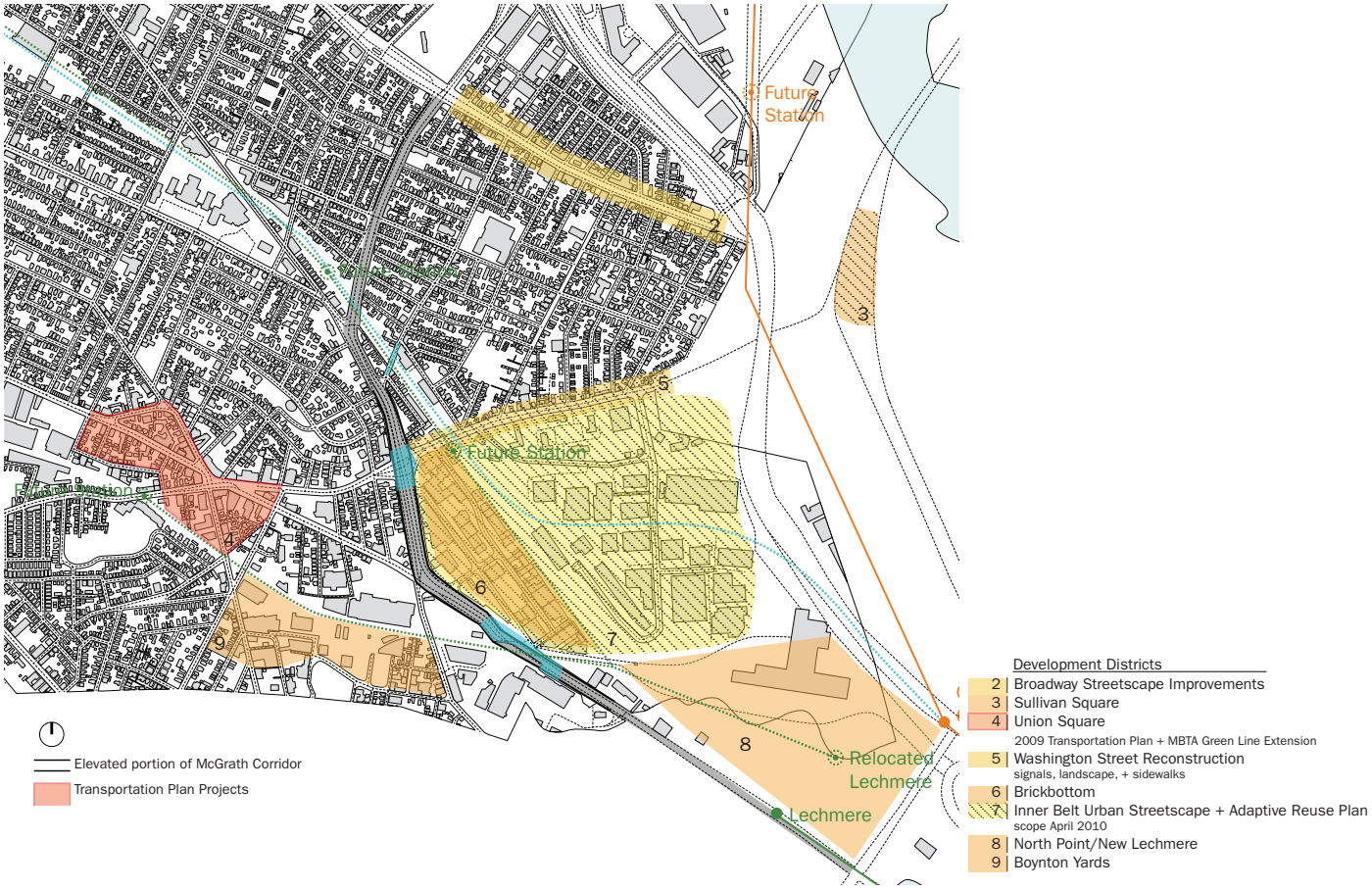


Figure 1-8: Coordinated Development and Infrastructure

public health impacts of a project can be quantified and incorporated into the decision making process.

The built environment in which we live, work and play has a tremendous impact on our collective health. It is becoming increasingly evident that it is easier to stay healthy when our surrounding environment enables healthy living. This means having places where we can easily and safely walk, run or bike; having access to amenities such as healthy food, affordable housing, transportation, and recreational opportunities; and enjoying the benefits of cleaner air and a safer environment. Recognizing that policy makers make choices everyday that should take public health into account, the Commonwealth of Massachusetts established the Healthy Transportation Compact (HTC). The HIA is a provision of the Healthy Transportation Compact section of the Transportation Reform Law.

The Healthy Transportation Compact is a key requirement of the landmark transportation reform legislation signed into law in June 2009. The HTC is co-chaired by the Secretary of Transportation and the Secretary of Health and Human Services and includes the Secretary of Energy and Environmental Affairs, MassDOT Highway Administrator, MassDOT Transit Administrator, and Commissioner of Public Health. The inter-agency initiative is designed to facilitate transportation decisions that balance the needs of all transportation users, expand mobility, improve public health, support a cleaner environment and create stronger communities.
Source: MassDOT website, http://www.massdot.state.ma.us/GreenDOT/HealthyTransportationCompact.aspx

An HIA provides the methodology to measure and incorporate the impacts of public health in decision making. Using a systematic process, a HIA assimilates data from a wide range of sources to ensure that the often overlooked public health implications, particularly to vulnerable populations, are incorporated into a public policy decision making process. A separate report on the HIA has been prepared as part of the Grounding McGrath study effort. That report details the process and outcomes of the HIA analysis conducted, and incorporates the alternatives and data included in this report. The primary steps used to conduct an HIA are briefly outlined below:

1. **Screening** – Determines the need and value of a HIA
2. **Scoping** – Determines which health impacts to evaluate, methods for analysis, and a workplan
3. **Assessment** – provides:
   a. A profile of existing health conditions
   b. Evaluation of potential health impacts of a public policy or project
4. **Recommendations** – Provide strategies to manage identified adverse health impacts
5. **Reporting** – includes:
   a. Development of the HIA report
   b. Communication of findings and recommendations
6. **Monitoring** – tracks:
   a. Impacts of the HIA on decision-making processes and the decision
   b. Impacts of the decision on health determinants

The Grounding McGrath study was chosen as the subject for a pilot HIA for the following primary reasons:

- As a highway de-elevation study, it represented potentially transformative change.
- It bisects the eastern part of Somerville, the most densely populated city in Massachusetts.
- It is a major corridor with local and regional costs and benefits.
- The corridor abuts environmental justice communities.
- The Grounding McGrath study had an established Working Group and civic engagement process, and was being conducted in coordination with ongoing municipal efforts, which ensured robust public involvement.
- When the subject for the pilot HIA was being selected, the Grounding McGrath study was still in the beginning stages, when the HIA process could be integrated relatively smoothly.

The HIA was conducted in parallel with the Grounding McGrath study, and completed by the Massachusetts Department of Public Health (DPH). The draft report,

Health Impact Assessment (HIA) of the Massachusetts Department of Transportation (MassDOT) Grounding McGrath Study, was released for public comment April 2013. The HIA was funded separately through a grant program from the Health Impact Project, a collaboration of the Robert Wood Johnson Foundation and The Pew Charitable Trusts. The findings of the HIA are documented in Chapter 5 – Alternatives Analysis and Chapter 6 – Recommendations of this report.

Public Outreach

MassDOT and its project team developed and implemented a robust program of community involvement during the Grounding McGrath study. Public outreach for the study had three principal goals:

- To provide an interactive, collaborative and credible public process;
- To equip the project team with ideas and recommendations from the public that will inform the study; and
- To solicit input from local residents and businesses, local and regional government agencies and interest groups, and to provide strategies to reach the wider public and highway users.

MassDOT conducted all meetings in accessible locations and provided opportunities to request accommodations for participants, including interpreters, audio equipment and large print materials.

Working Group

The work of the project team was supplemented by a Working Group, whose members included elected and municipal officials and representatives from state agencies, local advocacy groups, planning organizations and local architects. A full list of the Working Group membership is included in Appendix A. Members represented their communities, shared project information with their constituents,and reported feedback at Working Group meetings. Members also represented other ongoing planning processes and some were responsible for ongoing coordination between projects.

At the beginning of the project, MassDOT invited key members of the community to join the Working Group. While membership in the Working Group was limited to a small group, MassDOT and the project team worked to broaden participation beyond traditional choices, and all Working Group meetings were open and often attended by members of the general public. The Working Group met seven times at key points throughout the project, providing feedback and contributing to the direction of the project:

- June 29, 2011
- August 3, 2011
- December 12, 2011
- March 7, 2012
- September 27, 2012
- February 13, 2013
- April 25, 2013

Additional project meetings were held with the City of Somerville and the Department of Public Health to coordinate efforts with the IBBB Study and the HIA, respectively.

Public Meetings

A public meeting was held on September 20, 2011, at the conclusion of Task 2 (Existing Conditions and Issues Evaluation). In this meeting, the project team presented the results of the initial study area evaluation, existing conditions, and goals and objectives development, including the working group process. There was an opportunity for public questions and comments, and the public comments were taken into consideration during subsequent stages of the analysis. A second public meeting was held on May 15, 2013, to review the results of the Alternatives Analysis and Draft Recommendations.

Website

A project webpage was provided on the MassDOT website, www.massdot.state.ma.us/grounding mcgrath, which included:

- Information about upcoming meetings;
- All project presentations;
- Summary notes for all meetings/workshops on the project; and
- A way to sign up to be added to the project distribution list.

CHAPTER 2: EXISTING CONDITIONS

Introduction

This chapter presents an overview of the existing conditions within the study area, and beyond, for the Grounding McGrath study. This comprehensive picture of the varying components of the study area reflects the current and evolving conditions that influence the McGrath corridor. As described in Chapter 1, there were many factors considered in developing future alternatives for the McGrath corridor. The study began with a thorough examination of existing conditions such as regional traffic flows, local pedestrian and bicycle connections, public transit access, consistency with local plans, and the ability to spur economic development. This allowed key opportunities and issues to be identified that informed the analysis described in subsequent chapters.

Before the effects of any future alternative could be evaluated relative to study evaluation criteria, the first major step was to first understand the McGrath corridor and larger study area as they exist today. This chapter establishes, by category, an analysis of base (2011) year conditions to be used as a benchmark from which future conditions can be established and evaluated, and are presented in the categories described below:

McGrath Corridor - The physical characteristics of the corridor including the structures, roads, intersections, pedestrian, bicycle and public transportation infrastructure.

Demographics and Land Use - Population, employment, zoning and development analysis including recent trends.

Environmental Conditions - Description of environmental factors and conditions, including open space, wetlands, air quality and other factors, as needed.

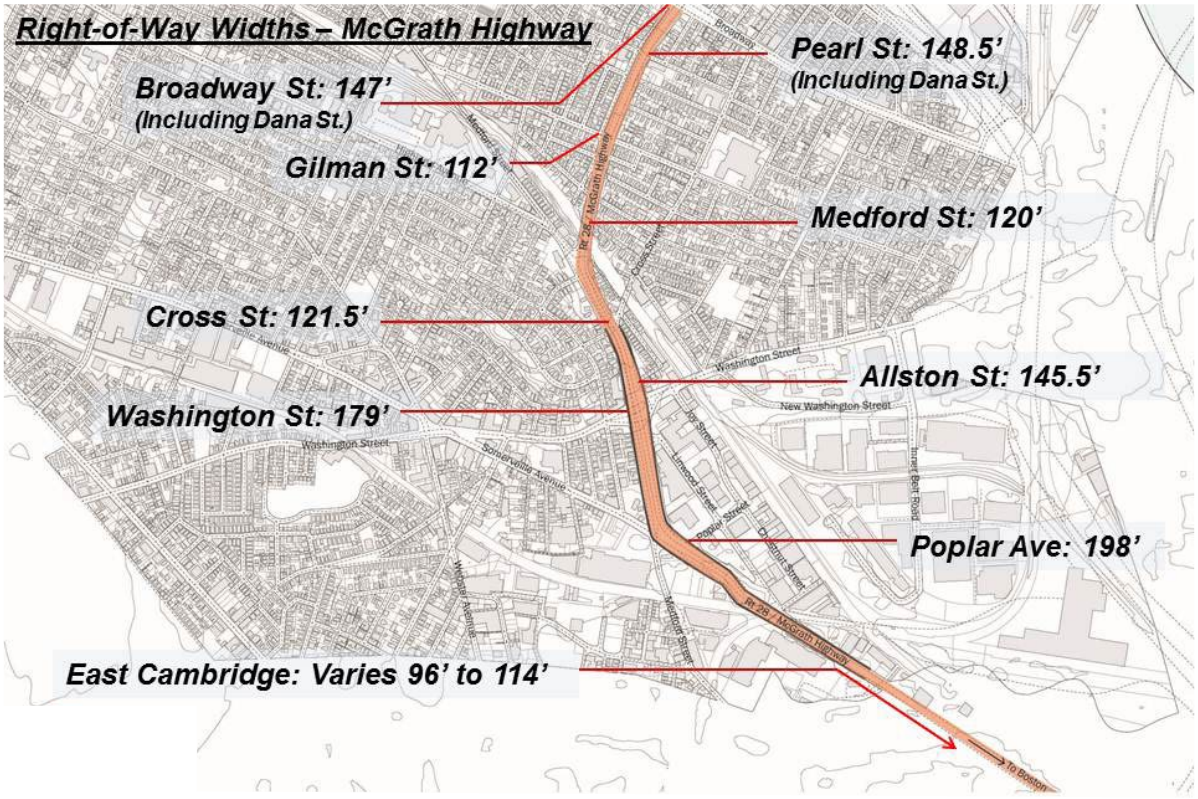


Figure 2-1: Right of Way Widths - McGrath Corridor

Current Transportation Utilization - Compilation of existing transportation utilization and analysis, including multi-modal volumes, levels of service, and crash data.

In establishing a comprehensive picture of the study area, data was compiled from a range of sources, including data directly collected through this study. Data sources are local and/or regional, depending on the category and level of detail necessary, and are generally cited either within the text or in the appendices included at the end of this study.

Moreover, through the interdisciplinary Existing Conditions analysis, the Grounding McGrath study identified the critical issues and opportunities that will drive the development of alternatives, and form the quantitative basis upon which to measure the alternatives to the Goals and Objectives. These issues and opportunities are presented at the end of the chapter and represent a distilled version of the larger trends, immediate needs, overall constraints and/or driving forces that were accounted for in the alternatives development and analysis tasks.

McGrath Corridor

The character and design of the McGrath corridor varies significantly throughout the study area. The overall right-of-way, now owned by MassDOT, ranges from 96 feet wide in parts of Cambridge, to almost 200 feet wide at the bend at Poplar Street in Somerville. Additionally, the McGrath corridor width varies as needed to include the elevated structures, their supports, and the access ramps. Within the right-of-way, MassDOT owns all of the at-grade roadways, associated sidewalks, and traffic signals. Figure 2-1 shows the corridor, and the right-of-way width at several locations.

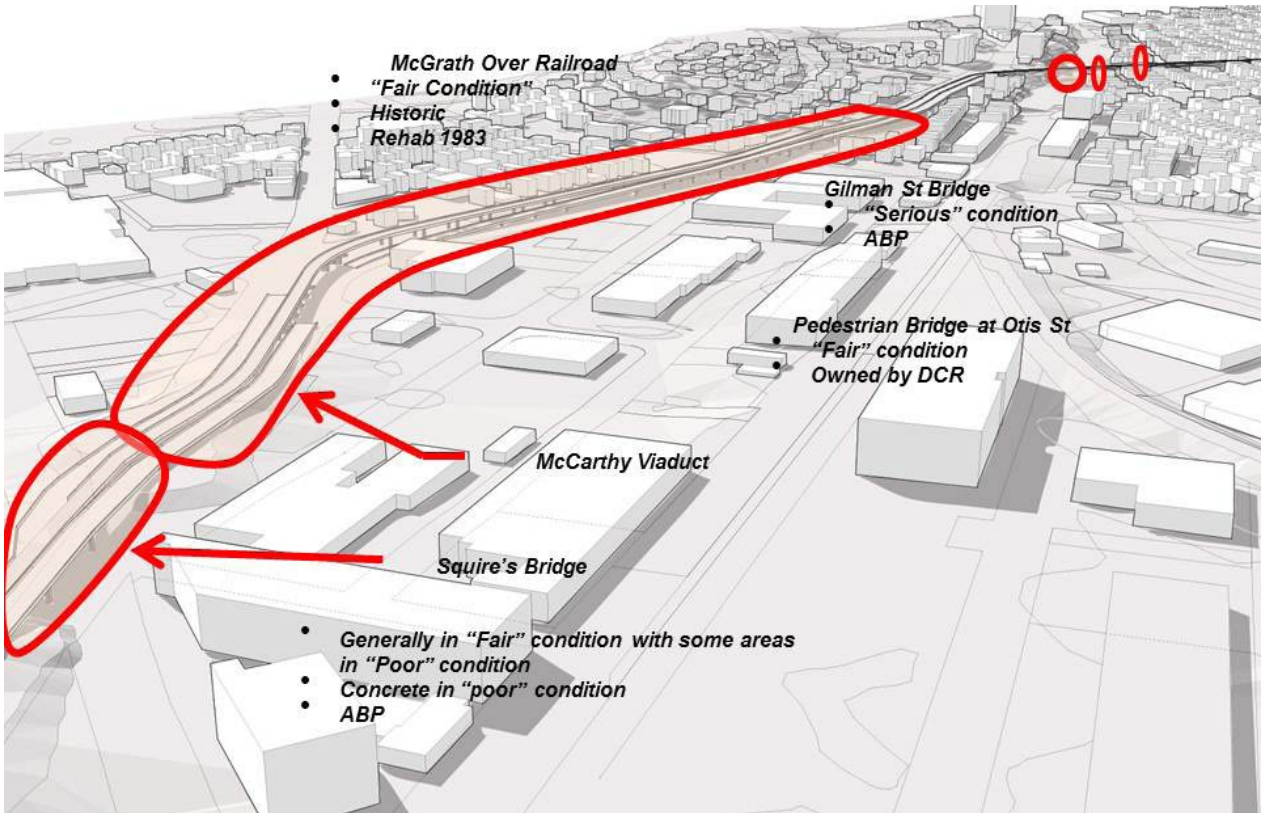


Figure 2-2: Key Structures

Consistent with Federal Highway Administration (FHWA) guidelines, MassDOT identifies a functional classification for various roadways as part of the Highway Performance Monitoring System. The functional classification of a roadway refers to the general character of a roadway and the type of service and access that it is intended to provide. Functional classifications include arterial, collector, and local roadways.

MassDOT Planning developed a function classification system with the same three general categories in 1993, in cooperation with the Metropolitan Planning Organizations (MPOs) and in accordance with Section 1006(c) of the Intermodal Surface Transportation Efficiency Act.[1] The main difference between the FHWA and MassDOT classification systems are that the FHWA system separates the interstates and local roadways into urban and rural designations and classifies limited access arterials (non-Interstates) separately from full-access arterials.[2]

As described in Chapter 1, Massachusetts State Route 28 within the McGrath study area is classified by MassDOT as an "other freeway", and also classified as "Other NHS Route" within the National Highway System (NHS) by the Federal Highway Administration.[3]

Structures

Although there may be a perception that the McGrath corridor consists of a monolithic structure, in reality the McGrath corridor is comprised of five key structures, as shown in Figure 2-2. The McCarthy Viaduct, McGrath Over the Railroad (Lowell Line Bridge), Gilman Street Bridge, and Squire's Bridge were all part of the recent transfer of the corridor to MassDOT, while the Otis Street pedestrian bridge is still owned by the Department of Conservation and Recreation (DCR). All of these structures are located in Somerville.

Two of the five structures were identified for repairs or replacement under MassDOT's Accelerated Bridge Program (ABP). The Gilman Street Bridge is currently being designed for replacement and the McCarthy Viaduct is currently undergoing short-term repairs and rehabilitation. The other three structures typically exhibit isolated areas of deterioration, but do not currently require any repairs in the short term. Based on regular physical inspection, MassDOT has given these three structures condition ratings by MassDOT inspection of *Fair* or *Satisfactory*. Conditions ratings are descriptors defined by the FHWA to determine the condition of a structure as follows:

- Fair is defined as "All primary structural elements are sound but may have minor section loss, cracking, spalling and scour".
- Satisfactory is defined as "Structural elements show some minor deterioration."

For additional detail, the actual Bridge Inspection reports are included in Appendix B.

Squire's Bridge

The Squire's Bridge was constructed in 1958 and rehabilitated in 1983. It is the southeastern most structure in the study area, and is comprised of three travel lanes, and a narrow sidewalk on each side of the guardrail-divided roadway. This elevated structure carries the McGrath corridor at an angle across the MBTA's Fitchburg Commuter Rail Line (see Figure 2-3). The proposed Green Line Extension (GLX) to Union Square is also being designed to use the Fitchburg Line right-of-way and travel under the Squire's Bridge. As it crosses active commuter rail lines, the Squire's Bridge cannot be brought to grade because MassDOT would not seek to create a new railroad grade crossing, especially one with frequent high-speed commuter rail traffic.

Furthermore, the Squire's Bridge must meet MBTA clearance requirements, and cannot be lowered. Along with the bridge over the Lowell Line (see below), it represents one of the "fixed points" in the study area; these structures are not being considered for

1 http://www.massdot.state.ma.us/planning/Main/MapsDataandReports/Maps/FunctionalClassification.aspx

2 http://www.massdot.state.ma.us/planning/Main/MapsDataandReports/Maps/FederalFunctionalClassification.aspx

3 http://services.massdot.state.ma.us/maptemplate/roadinventory

Figure 2-3 : Squire's Bridge (S-17-024) - Looking West Along the Fitchburg Commuter Rail Line

Figure 2-4 : McCarthy Viaduct (S-17-039) View of McGrath along at-grade segment near Poplar Street

reconstruction or reconfiguration, since addressing the clearance requirements would require a much more complex and expensive solution such as raising the bridge or tunneling, or changes to the GLX already in advanced design.

The bridge is in "fair" condition, with isolated problem areas along the steel beams and concrete piers. There is rusting at the deck joints, and spalls and cracks in the concrete piers and abutments.

McCarthy Viaduct

The McCarthy Viaduct, built in 1951, is the longest segment structure in the McGrath corridor. The elevated overpass carries two lanes of traffic in each direction along the corridor, beginning at the Highland Avenue/ Medford Street intersection. In the southbound direction, the structure continues and connects to the Squire's Bridge, with two off ramps – one to Washington Street and the other to Somerville Avenue. In the northbound direction, the structure begins after a short at-grade section at Poplar Street, and serves primarily to provide an unimpeded, grade-separated "flyover" movement over Washington Street. There are no sidewalks on the McCarthy Viaduct itself, and pedestrians are not allowed on the structure. There are no dedicated bicycle facilities.

Figure 2-5 : McCarthy Viaduct (S-17-039) View of McGrath along at-grade segment at the Washington Street Intersection

The steel beams were given a “Fair” condition rating due to rusting at the deck joints and concrete was rated in “Poor” condition, due to spalls and exposed reinforcements. The steel and concrete repairs to the viaduct are currently underway as part of the ABP. See Figure 2-4 and Figure 2-5 for a view of the McCarthy Viaduct from Poplar Street and Washington Street.

McGrath over Railroad (Lowell Line Bridge)

The McGrath overpass over the Lowell Line is the oldest structural segment of the McGrath corridor (see Figure 2-6). This historic bridge was first built in 1908 and was rehabilitated in 1983. The Lowell Line Bridge is just north of the McGrath corridor intersection with Medford Street and Chester Avenue. The bridge is at a higher overall elevation than the McCarthy Viaduct because the topography in this area builds towards Prospect Hill.

The Lowell Line Bridge carries three lanes of traffic in each direction, separated by a median. Narrow sidewalks exist on both sides of the bridge, separated from the roadway by the bridge structure itself. The Lowell Line Bridge carries the entire McGrath corridor over the MBTA’s Lowell Commuter Rail Line. This rail corridor is the planned route of the main trunk of the GLX, and will also incorporate the Somerville Community Path discussed later in this chapter. As with the Squire’s

Figure 2-7 : Gilman Street Bridge (S-17-025) - Looking West Along Gilman Street

Figure 2-6 : McGrath over Railroad (S-17-022) - Looking North from Medford Street Intersection

Figure 2-8 : Pedestrian Bridge at Otis Street (S-17-041) - Looking South Along McGrath

Bridge, this structure represents a "fixed point" in that MBTA clearance requirements must be maintained, and addressing any changes would be complex, costly and disruptive to the GLX process.

The Lowell Line Bridge was given a "Fair Condition" rating, as primary structural elements are sound but may have minor section loss, cracking, spalling and scour.

Gilman Street Bridge

The Gilman Street Bridge was built in 1908 and rebuilt in 1926. It is located between the Pearl Street and Medford Street intersections, just north of the Lowell Line Bridge. This three-span bridge structure carries three approximately 12-foot wide lanes in each direction above Gilman Street, and includes a sidewalk on each side. The bridge tunnel underneath requires about 11' - 4" feet for minimum vertical clearance for vehicles along Gilman Street (see Figure 2-7). Sidewalks on either side of Gilman Street are narrow, but provide an important link connecting the neighborhoods on either side of the corridor.

The structure was rated in "Serious" condition, with extensive rusting and large cracks in the foundation. As noted previously, it will be replaced as part of the ABP. As of this writing, it is anticipated that bridge construction will start in the summer of 2014 and end in summer of 2016.

Pedestrian Bridge at Otis Street

The pedestrian bridge at Otis Street was constructed in 1964 and is still owned by DCR. This elevated footbridge spans across the McGrath corridor along Otis Street (see Figure 2-8). It was constructed as a passageway for pedestrians to provide separated walking access across the McGrath corridor, and is the only crossing in the quarter mile between Pearl Street and Broadway. The Otis Street pedestrian bridge is accessed via ramp structures on the east side of the McGrath corridor and on the west side of Dana Street. The bridge also provides an important link from East Somerville to the Otis Street Playground. The pedestrian bridge is comprised of a pre-stressed concrete deck.

The bridge was given a "Fair Condition" rating, as primary structural elements are sound but may have minor section loss, cracking, spalling and scour.

Existing Roadway

The McGrath corridor curves and changes direction within the study area. North of Poplar Street (in the vicinity of the Squire's Bridge and the Inner Belt/ Brickbottom area) the McGrath corridor is primarily a north-south roadway. South of this area, the McGrath corridor travels in a southeast to northwest direction. However, the roadway is predominantly north-south, and is described as a north-south roadway for the purposes of this report.

The existing roadway conditions also change along the corridor depending on access needs for local neighborhoods and whether or not the roadway is elevated. The elevated segments of the McGrath corridor, from the north at the Gilman Street Bridge to the southern point at the Squire's Bridge, provide ramps that allow motor vehicles access to surface roads. The elevated portion of the McGrath corridor generally includes two travel lanes in each direction.

North and south of the elevated portion, the roadway is at-grade and provides access to a variety of land uses and neighborhoods. The existing roadway conditions in the northern segment of the corridor, north of the Lowell Line Bridge, accommodate three 12-foot travel lanes in each direction and a buffered median that divides both directions. Directly beside the McGrath corridor is a one-way residential street, which is separated by a divisional island. There is no bicycle accommodation, but there are two 10-foot sidewalks that outline the extent of the right-of-way. The existing at-grade sections of roadway provide travel lanes ranging from 10 to 12 feet wide, with medians that range from 4.5 feet to 8 feet wide. Sidewalks along at-grade sections of roadway range from 6 feet to 10-feet wide.

See Figure 2-9 for existing cross-sections at the following locations along the McGrath corridor:

- Between Pearl Street and Broadway
- Rufo Road to Sciarappa Street
- Sciarappa Street to Third Street
- South of Third Street

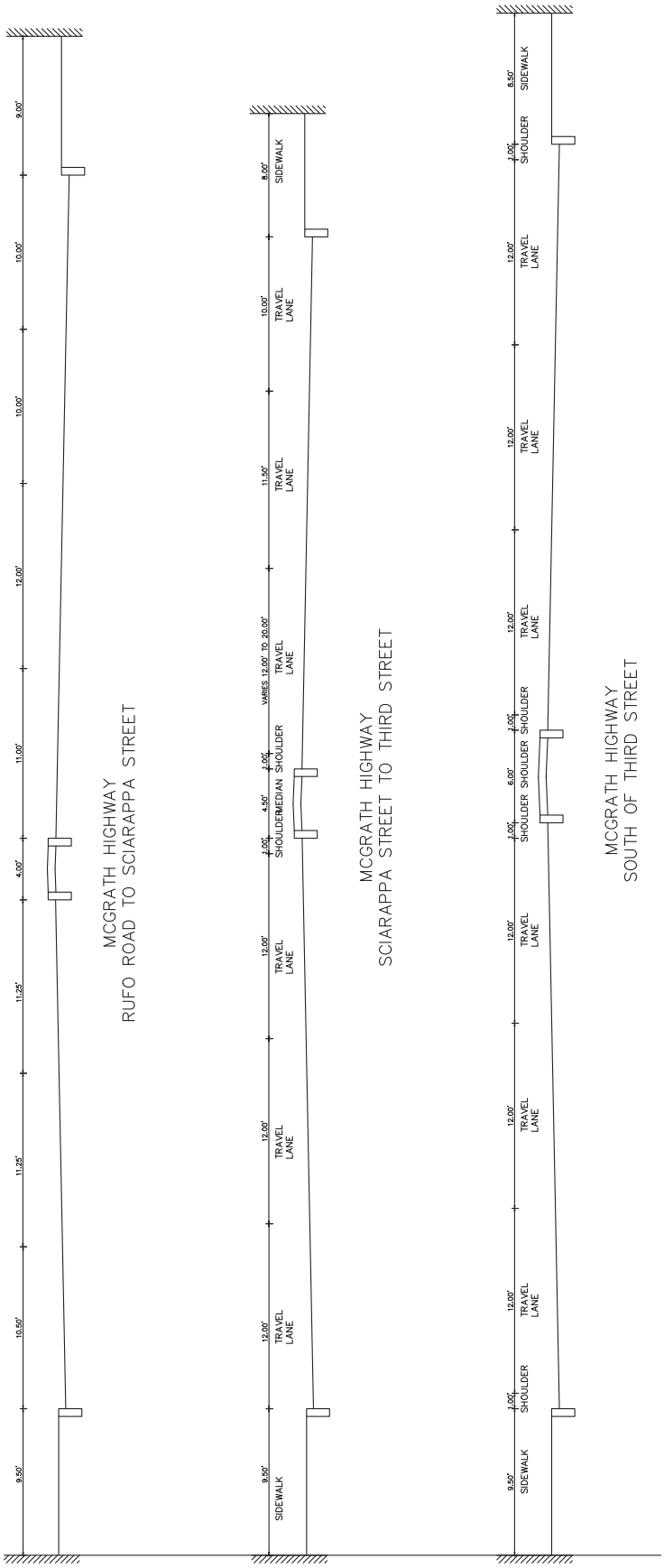


Figure 2-9 : Existing Cross-Sections of Right-of-Way

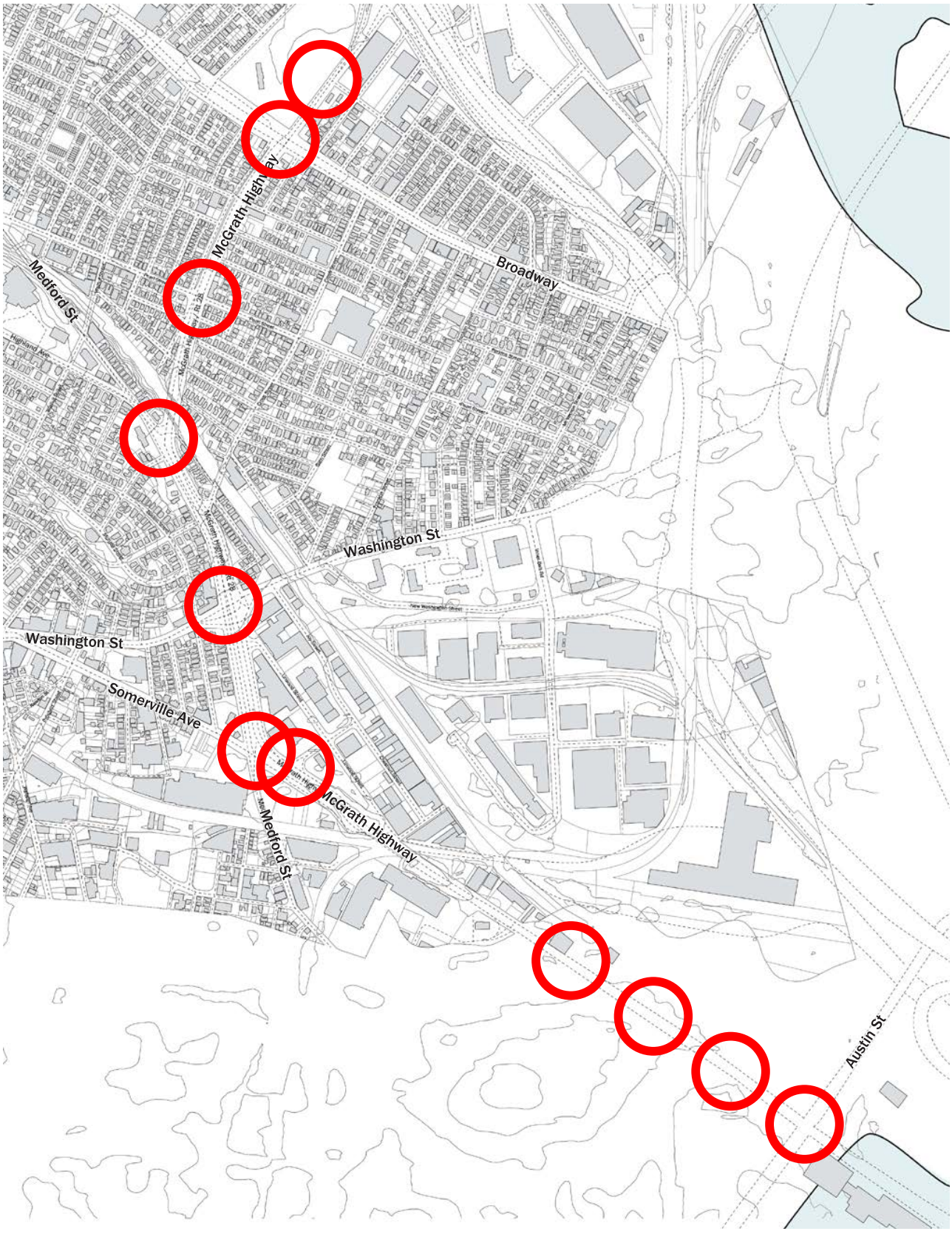


Figure 2-10 : Study Area Intersections

Intersections

As described in Chapter 1, the study area consists of the McGrath corridor from Broadway in Somerville to the north, to Land Boulevard in Cambridge to the south, and includes the following intersections as shown in Figure 2-10:

- Blakeley Avenue
- Broadway
- Pearl Street
- Medford Street/Highland Street
- Washington Street
- Poplar Street
- Somerville Avenue/Medford Street
- Rufo Road
- Third Street
- Cambridge Street/East Street
- Land Boulevard/Austin Street

Existing Intersection Geometry

The various roadway configurations at each of the study area intersections are depicted in Figure 2-11 and are described below in order from north to south.

Blakeley Avenue: Blakeley Avenue is located north of Broadway and provides access into the Super Stop and Shop Plaza and the adjacent residential neighborhood of East Somerville. The northbound McGrath corridor approach provides four travel lanes. Right-turns are permitted onto Blakeley Avenue. The southbound McGrath corridor approach provides three through lanes prohibiting left-turns and U-turns at the signalized intersection. The Blakeley Avenue approach has an exclusive left-turn lane and an exclusive right-turn lane. A pedestrian crosswalk is provided across Blakeley Avenue, but not across the McGrath corridor.

Broadway: Broadway is classified as an urban principal arterial to the east of the McGrath corridor and as an urban minor arterial west of the McGrath corridor. Broadway is signalized at its intersection with McGrath, providing protected signal phases for the McGrath corridor exclusive left-turn movements, split phasing for the Broadway movements, as well as concurrent pedestrian phasing. The northbound and southbound intersection approaches provide an exclusive left-turn lane, two through lanes and a shared through/right-turn lane in each direction. The eastbound Broadway approach contains an exclusive left-turn lane, a shared left-turn/through lane, two through lanes and a right-turn lane. The westbound Broadway approach contains an exclusive left-turn lane, a shared left-turn/through lane, through lane and a channelized right-turn lane. Pedestrian crosswalks and median refuges are provided across each of the intersection approaches and channelized lanes.

Pearl Street: Pearl Street is classified as an urban collector and intersects with the McGrath corridor north of the Gilman Street Bridge. The intersection of Pearl Street and the McGrath corridor is signalized and provides an exclusive pedestrian phase. The northbound and southbound McGrath corridor approaches provide an exclusive left-turn lane, two through lanes and a shared through/right-turn lane in each direction. The eastbound Pearl Street approach provides a shared left-turn/through lane and an exclusive right-turn lane. The westbound Pearl Street approach contains a single general purpose lane. Crosswalks are provided across each approach of the intersection.

Medford Street/Highland Avenue: Medford Street, an urban minor arterial, intersects with the McGrath corridor in a “T” intersection configuration, just east of the merge with Highland Avenue. Medford Street is signalized at its intersection with the McGrath corridor. The McGrath corridor northbound provides two-left turn lanes and three through lanes, and the southbound approach provides two through lanes and a shared through/right-turn lane. The Medford Street approach provides an exclusive left-turn lane and two right-turn lanes. Chester Avenue which is a one-way street under stop control also intersects the McGrath corridor at this location. Crosswalks are located across all of the approaches of the intersection and the traffic signal provides an exclusive pedestrian crossing phase.

Washington Street: Washington Street is classified as an urban principal arterial and provides access to Union Square to the west and to Sullivan Square and Interstate 93 to the east. Washington Street travels beneath

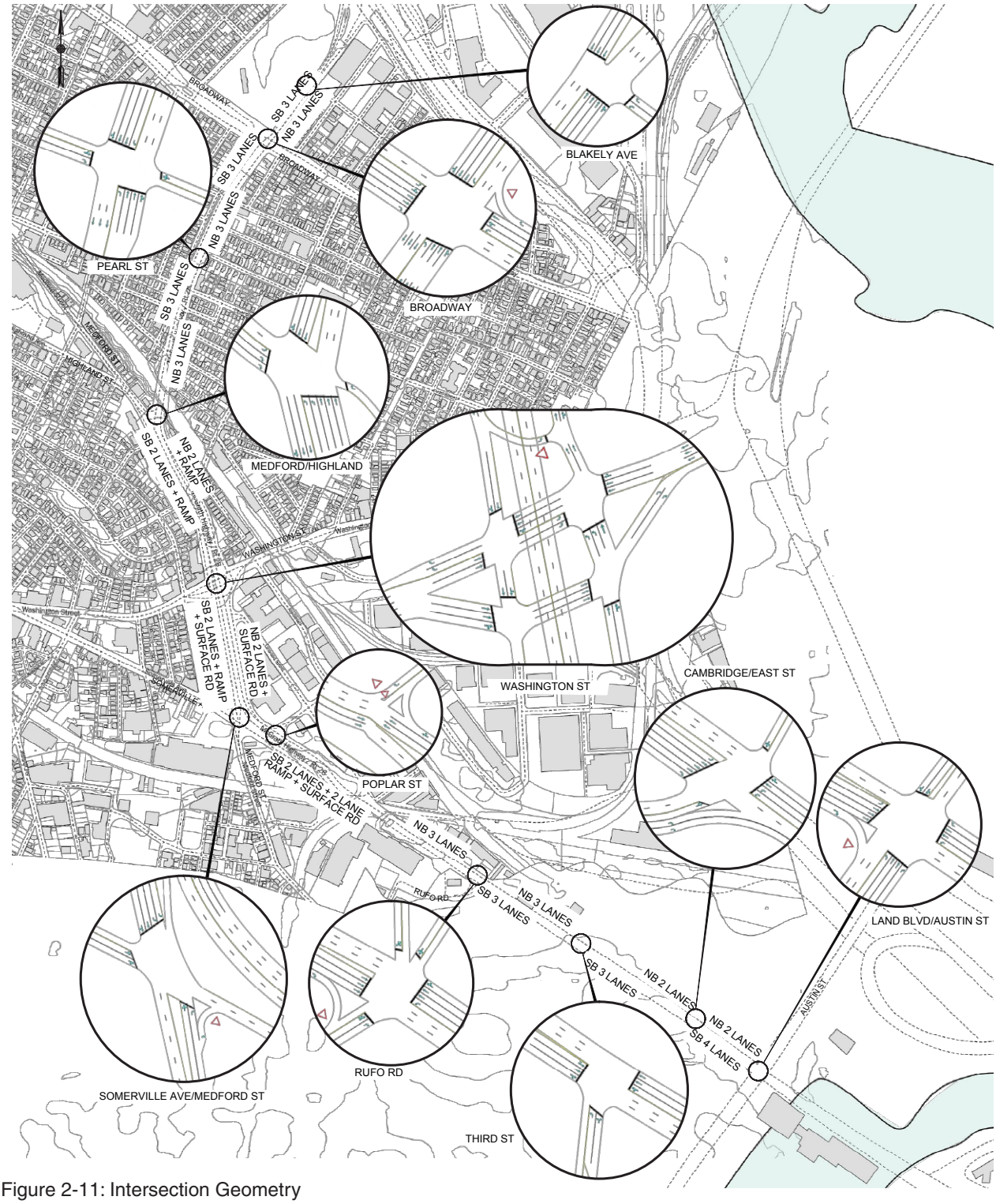


Figure 2-11: Intersection Geometry

the elevated portion of the McGrath corridor and intersects with its on- and off-ramps. The intersection of Washington Street and the McGrath corridor ramps is signalized. The configuration of the intersection of the McGrath corridor's ramps and Washington Street is complicated but each approach can be broken down into simpler roadway geometries:

- The northbound McGrath corridor off-ramp contains two travel lanes, which expand to two left-turn lanes, a through lane and a right-turn lane.
- The southbound McGrath off-ramp provides two travel lanes through the intersection providing full access to Washington Street as well as a U-turn to the McGrath corridor northbound.
- The eastbound Washington Street approach provides two left-turn lanes and three through lanes.
- The westbound Washington Street approach contains three general purpose lanes providing full access to the McGrath corridor and Washington Street.

Somerville Avenue/Medford Street: The signalized intersection of Somerville Avenue and Medford Street is located at-grade, west of Poplar Street, and provides access to and from the McGrath corridor southbound. Medford Street runs parallel to the elevated segment of the McGrath corridor. Somerville Avenue provides access to Union Square. Ramps to and from the elevated portion of the McGrath corridor southbound are also included in this signalized intersection. The northbound Medford Street approach provides a shared left-turn/through lane, a through lane and a channelized right-turn lane. Medford Street continues north within the Route 28 right-of-way as a tunnel section under Route 28, between Somerville Avenue and Washington Street. The southbound approach, combined from Medford Street and the McGrath corridor southbound off-ramp, provides two left-turn lanes, a through lane and a shared through/right-turn lane. The eastbound Somerville Avenue approach contains two general purpose lanes, providing full access to Medford Street and the McGrath corridor. Crosswalks are provided across the northbound Medford Street approach, the eastbound Somerville Avenue approach and the southbound McGrath corridor ramp approach.

Poplar Street: Poplar Street intersects with the at-grade northbound portion of the McGrath corridor and provides access into the Brickbottom area of Somerville. The intersection is a right-in/right-out stop-controlled intersection, with three through lanes on the McGrath corridor and a single approaching lane on Poplar Street. No crosswalks exist at this intersection.

Rufo Road: Rufo Road provides access to the Twin City Plaza, located southeast of the Squire's Bridge. This signalized intersection also provides access to a car wash and shopping plaza on the east side of The McGrath corridor. The northbound McGrath corridor approach provides an exclusive left-turn lane and three through lanes permitting right turns to the north. The southbound approach provides three through lanes and a channelized right-turn lane and prohibits left turns and U-turns to the north. The eastbound Rufo Road approach contains a right-turn lane and a left-turn lane providing full access to The McGrath corridor and the adjacent driveways. Crosswalks are provided on the northern leg and western leg of the signalized intersection.

Third Street: The intersection of the McGrath corridor and Third Street is a signal controlled "T" intersection located north of Cambridge Street, providing access to Kendall Square to the south. The northbound McGrath corridor approach contains a shared left/through lane and two through lanes, and the southbound approach contains two through lanes and a shared through/right-turn lane. The eastbound Third Street approach provides two travel lanes, an exclusive left-turn lane and a shared left-turn and right-turn lane. Crosswalks are located across the Third Street and northbound McGrath approaches to the intersection, and both exclusive and concurrent pedestrian phases are provided by the traffic signal.

Cambridge Street/East Street: South of Third Street is the signalized intersection of the McGrath corridor and Cambridge Street and East Street. Cambridge Street provides access into East Cambridge and East Street provides access into the NorthPoint development. The northbound McGrath corridor approach provides two exclusive left-turn lanes onto Cambridge Street, a through lane and a shared through/right-turn lane. The southbound McGrath corridor approach contains

an exclusive left-turn lane, three through lanes and an exclusive left-turn lane. Cambridge Street provides an exclusive left-turn lane, providing access to the McGrath corridor northbound and East Street, and two through lanes providing access to The McGrath corridor southbound. The westbound East Street approach provides a single general purpose lane and bike lane. Access to the bus terminal at Lechmere Station is also provided at this intersection. Crosswalks are located at each approach. The intersection of Cambridge Street and First Street is located approximately 250 feet west of the McGrath corridor and operates in coordination with the East Street intersection.

Land Boulevard/Austin Street: Land Boulevard and Austin Street intersect with the McGrath corridor at the southern end of the study area. Land Boulevard provides access to Kendall Square and Austin Street provides access to Charlestown. The northbound McGrath corridor approach provides an exclusive left-turn lane, two through lanes and an exclusive right turn lane. The southbound McGrath corridor approach contains an exclusive left-turn lane, three through lanes and a channelized right-turn lane. The eastbound Land Boulevard approach provides an exclusive left-turn lane, two through lanes and an exclusive right turn lane and the westbound Austin Street approach contains two general purpose lanes. The traffic signal provides concurrent pedestrian phasing and crosswalks are provided across all but the southbound Austin Street approach.

On-Street Parking

On-street parking is currently not permitted on the McGrath corridor itself. As shown in Figure 2-12, on-street parking within the study area is located only on the parallel surface roads, owned by the City of Somerville, along the west side of the McGrath corridor. Parking is provided on Dana Street, between Broadway and Pearl Street, and on Medford Street, slightly north of Prospect Hill Avenue to Somerville Avenue. Additional on-street parking as located on adjacent cross-streets, primarily serving local abutting land uses.

Pedestrian and Bicycle

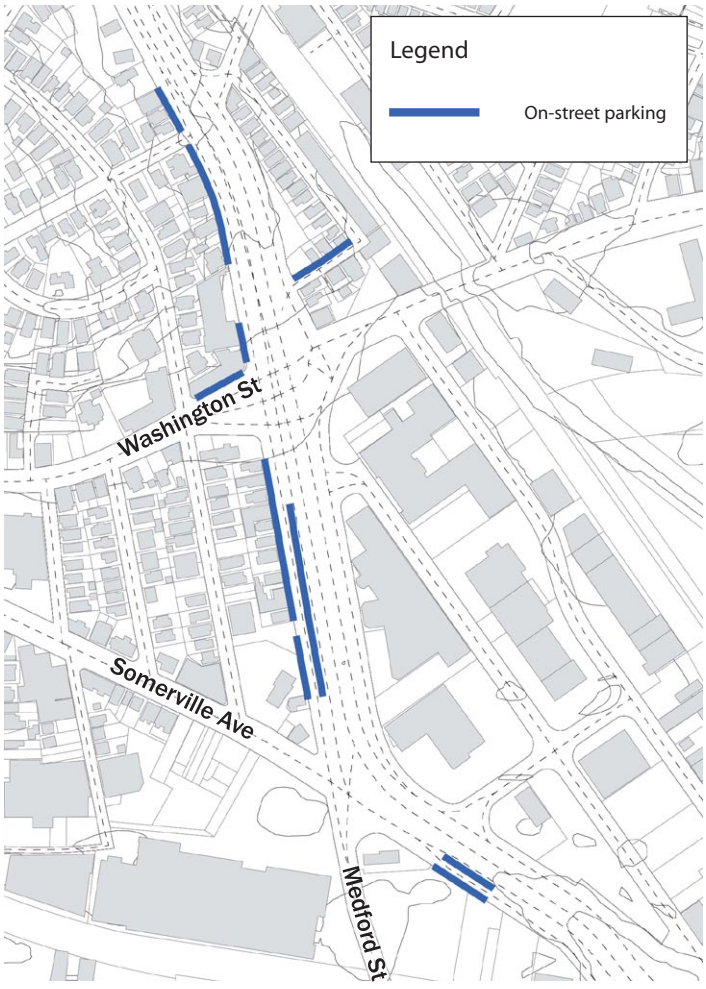
Pedestrian and bicycle access across the McGrath corridor within the study area is very limited.

The current design of the roadway, with elevated structures allowing high speeds, does not give pedestrians and bicyclists many safe access points. Unmet pedestrian and bicycle desire lines include in particular east/west connections across the corridor. Examples provided by the Working Group for desirable connections include Somerville Avenue to and from Brickbottom, and Washington Street east and west of the McGrath corridor. These locations were also identified by Working Group members for bicycle access, in addition to improved access along the McGrath corridor between Broadway and the Medford Street/Highland Avenue intersection.

The ramps and bridges over and on the McGrath corridor are less than desirable and pose significant safety risks to travel on foot and by bicycle. Most importantly, the infrastructure is inconsistent: a pedestrian or cyclist can start a journey on one portion of the corridor, but is left stranded without a choice but to turn around and take an alternative route.

The bicycle and pedestrian accommodations, or lack thereof, on the McGrath corridor structures also present major challenges.

The McCarthy Viaduct and its connecting ramp structures provide no sidewalks or accommodations for cyclists. Although records indicate that bicycling on the viaduct is legal, it is certainly both uninviting and potentially unsafe. With unimpeded vehicle movements and a long stretch of elevated roadway, vehicles are invited to travel at higher speeds and do not expect to encounter cyclists. Those who do cycle have to use a small shoulder or the right travel lane amongst these higher-speed vehicles to use the viaduct. Thus, all non-motorized travelers are typically accommodated on the adjacent, parallel roadway.



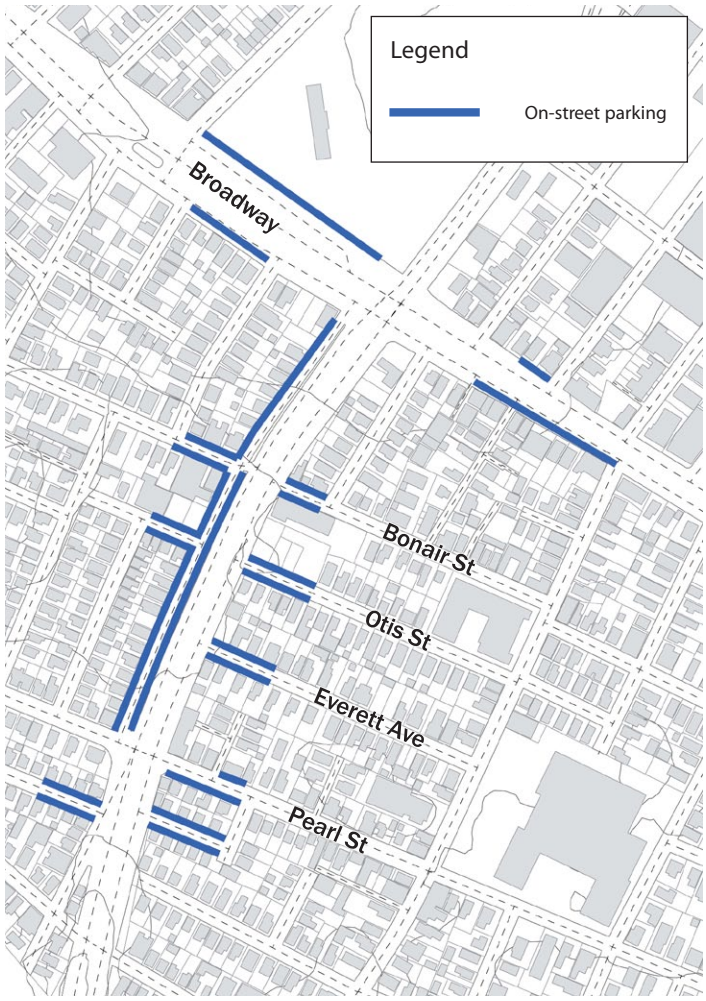


Figure 2-12 : On-Street Parking

Whether elevated or at-grade, the McGrath corridor physically, visually and functionally divides neighborhoods, separating Prospect Hill from East Somerville, and Brickbottom from Union Square. The lack of connectivity across and along the McGrath corridor creates accessibility, health, and safety issues for people who are walking and biking. Somerville is a dense city with many residential areas, especially around the McGrath corridor, and has been shown though the HIA study to exhibit higher levels of public health issues than the region as a whole. With limited access to needed amenities (parks, supermarkets) for improved health, this pedestrian barrier presents an ever more complex challenge. In fact, Somerville is so dense and compact that it does not offer school buses to its students, and thus students and parents without access to a vehicle must walk - exacerbating the impact of any pedestrian barriers.

The lack of pedestrian and bicycle infrastructure along the McGrath corridor may also contribute to discouraging investment in the building stock along the McGrath corridor. One of the prime motivations of the Grounding McGrath study has continually been to improve pedestrian and bicycle connections along and across the McGrath corridor. As Union Square revitalization continues, plans for the development of Brickbottom are formulated, and the GLX is implemented, connections along the McGrath corridor will only become more important to the future of these areas.

Sidewalks

Consistent with its densely populated and heavily urbanized context, the McGrath corridor generally has a comprehensive sidewalk network, albeit one that has significant shortcomings. Sidewalks are missing or broken in several areas, and in other places these facilities are too narrow or do not meet ADA accessibility standards. The sidewalks within the McGrath corridor are relatively narrow (about 4 to 8 feet wide), and they are generally immediately adjacent to the corridor's high-speed travel lanes, with no buffer.

Sidewalks are present along the surface segments of the McGrath corridor at the following locations:

- Broadway and Washington Streets, both sides of the street, including on Gilman Street Bridge crossing the railroad tracks north of Medford Street.
- Medford Street, between Washington Street and Somerville Avenue.
- South of Somerville Avenue, both sides of the street, including Squire's Bridge. Sidewalks on the Squire's Bridge are separated from traffic by a barrier. Access to the Squire's Bridge is provided via ramps at Poplar Street, or by using staircases built into the bridge structure closer to the Fitchburg Line tracks at the Somerville Avenue extension.

Another issue in the study area is the number of curb cuts, particularly along the southern end of the McGrath corridor. Curb cuts expose pedestrians to traffic entering and exiting the roadway, causing more points of conflict and safety concerns. This is especially true for a high-speed corridor with no buffer between the travel lanes and the sidewalks.

Most of the side streets that connect to the McGrath corridor have sidewalks on both sides, including Broadway, Medford Street, Washington Street, and Somerville Avenue. However, few of these sidewalks connect across the McGrath corridor, providing only "T" intersections for pedestrians at many of these locations. Consequently, this prevents many pedestrians from crossing the McGrath corridor on trips that otherwise would be easily accomplished. Also, on these side streets, similar to the McGrath corridor, the quality of the sidewalks is generally low. Numerous curb cuts interrupt the sidewalks, including a curb cut over 200-feet long on Somerville Avenue, just to the west of the McGrath corridor.

Roadway Crossings

To cross over the McGrath corridor, pedestrians and cyclists must travel much longer distances than they otherwise would within typical Somerville city blocks. Crosswalks are at least 1,000 feet apart in many places along the McGrath corridor, as shown in Figure 2-13. In an urban area, a typical city block of about 300 feet is seen as desirable to foster connections, and allow for pedestrian mobility. Limiting block length is one of the

design principles for encouraging pedestrian connectivity. As seen in other parts of Somerville and Cambridge, older urban cities in the United States usually have block lengths less than 500 feet, and some communities are beginning to establish maximum block lengths for new development. The theory is that shorter blocks mean more intersections, which allows shorter travel distances and greater number of routes between locations.

At more than three times the recommended length of 300 feet, the crossings of McGrath are closer to a quarter mile apart. With the elevated structures, ramps and high traffic volumes, there are extremely limited opportunities to improve the crosswalk connectivity in the current configuration. The lack of connectivity makes the McGrath corridor a major barrier to access destinations by foot from one side to the other.

There are several major crossings (described from north to south along the corridor) that were observed in 2011 as part of the Grounding McGrath Study. MassDOT Highway District 4 responded to local concerns about the need to improve crossings, and installed pedestrian signals and crosswalks in several locations by 2012 (see Figure 2-14):

- At Broadway: This four-way intersection with raised medians on each leg makes crossing distances much shorter. Crosswalks are present at each crossing. The longest distance to cross is about 60 feet; the shortest is about 40 feet. Curb extensions (particularly on the west side of the intersection) substantially reduce the travel distance from

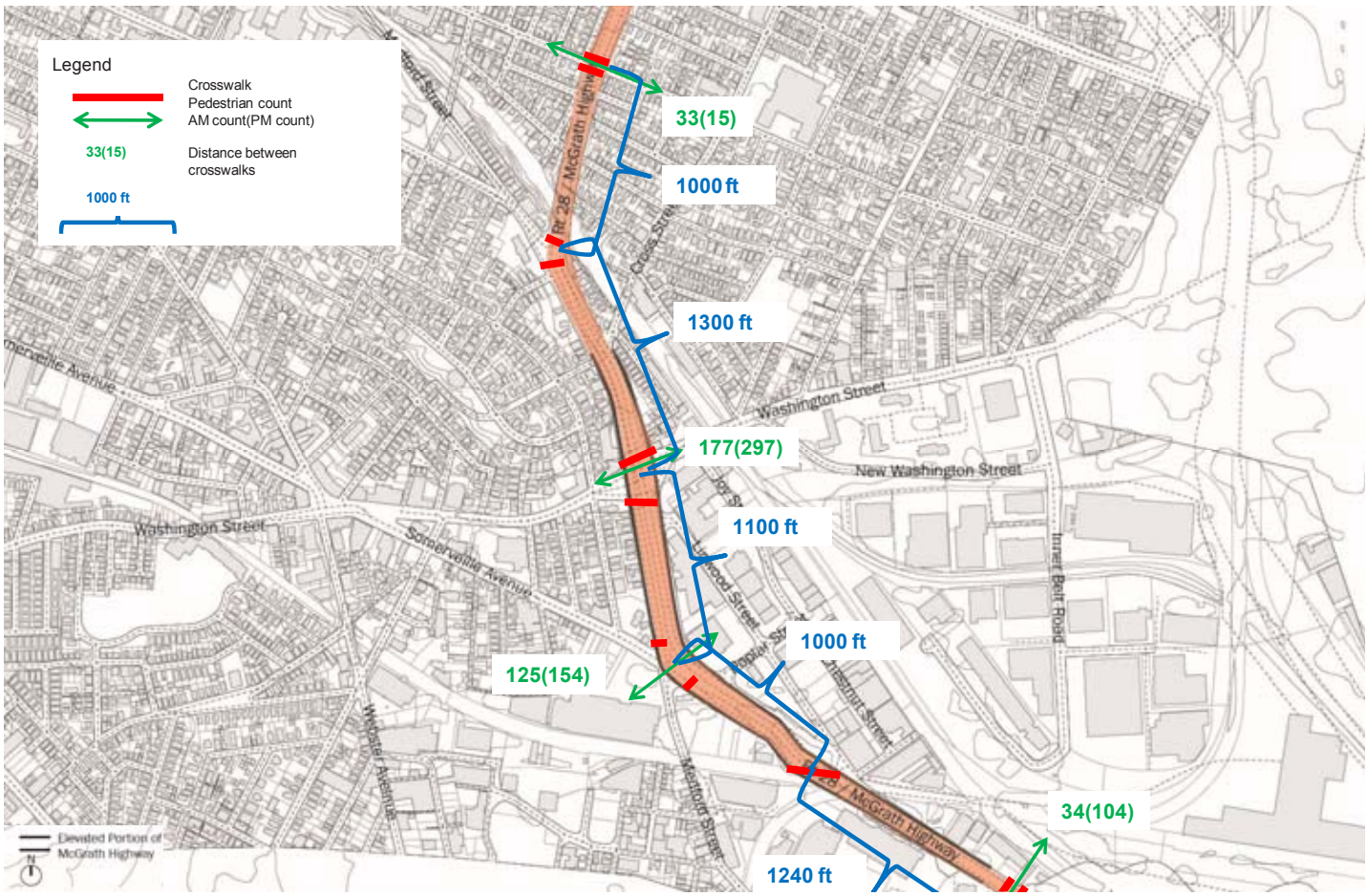


Figure 2-13 : Existing Crosswalk Length Measurements along McGrath

curb to curb. Curb extensions, or bulb outs, extend the sidewalk into the parking lane to narrow the roadway and provide additional pedestrian space at key locations. They can improve pedestrian safety by increasing pedestrian visibility to drivers, shorten crossing distance, and encourage drivers to slow down. Pedestrian signals are present, but do not have countdown timers. Pedestrian signals are concurrent with vehicular signals, meaning pedestrians receive a "walk" signal for the same direction as vehicles with a green signal.

- Between Bonair Street and Otis Street: A 200-foot long elevated pedestrian bridge crosses over the McGrath corridor and Dana Street, providing a direct connection for residents, customers to area businesses, and to the Otis Street Playground. The pedestrian bridge was likely constructed to improve pedestrian safety crossing the McGrath corridor. However, this is not ideal and an unfriendly way to cross the roadway, because the ramp structures are long, and the bridge deck can feel isolated from the surrounding area given its height over the corridor and its over 100 foot length. Field observations note that it is not highly used.
- At Pearl Street: This four-way intersection has crosswalks at each leg, with an exclusive pedestrian signal phase (i.e., vehicles are stopped when pedestrians receive a "walk" signal). While narrow medians exist on the McGrath corridor between north and southbound traffic, the medians do not provide sufficient shelter to pedestrians, and the signals are currently designed for a pedestrian to make the crossing of approximately 90 feet of highway (six lanes of traffic and one turn lane) in a single move. Pearl Street is a much shorter crossing of about 50 feet.
- At Medford Street: This intersection design is more complicated and has wider turn radii for cars to navigate on and off of the McGrath corridor. Providing wider turn radii for vehicles generally creates longer crosswalks for pedestrians. Although crosswalks are present on each leg of

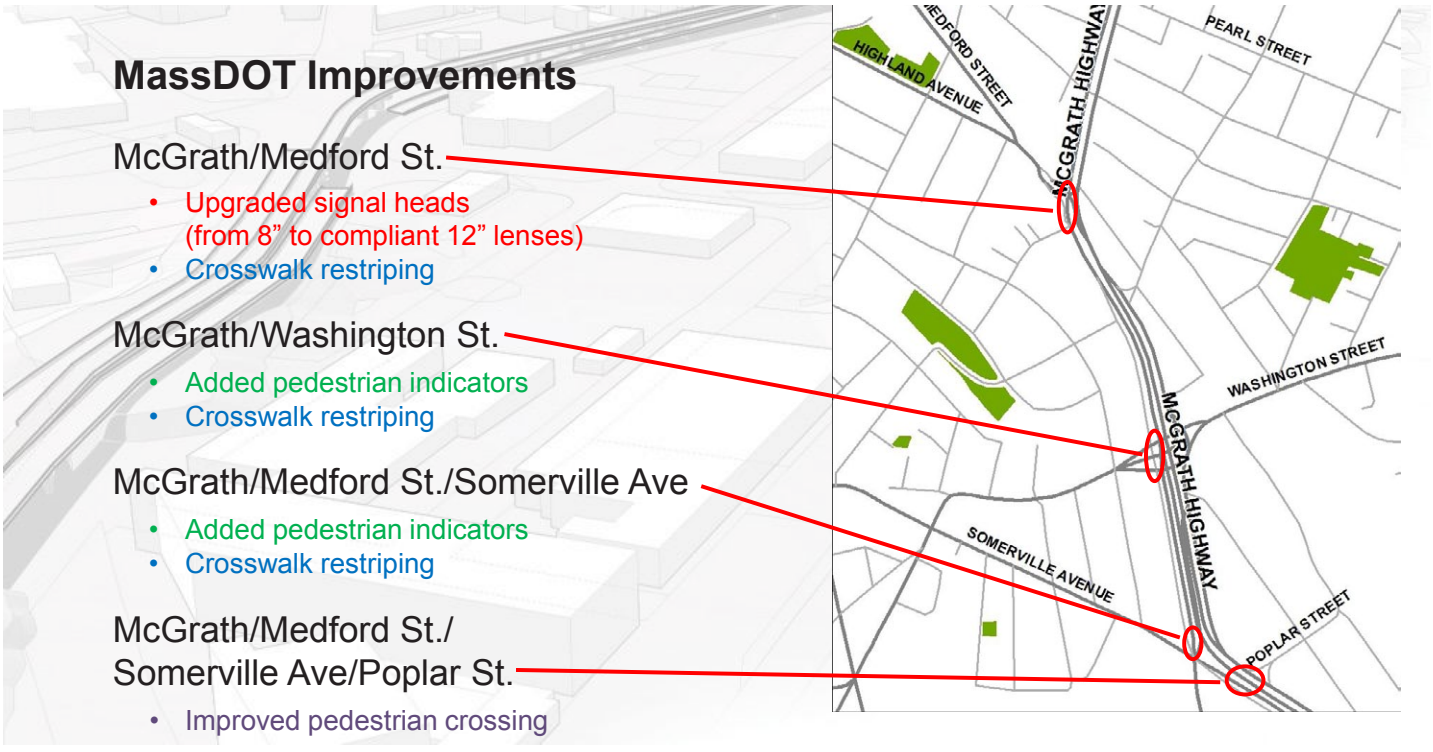


Figure 2-14 : MassDOT short-term pedestrian crossing improvements

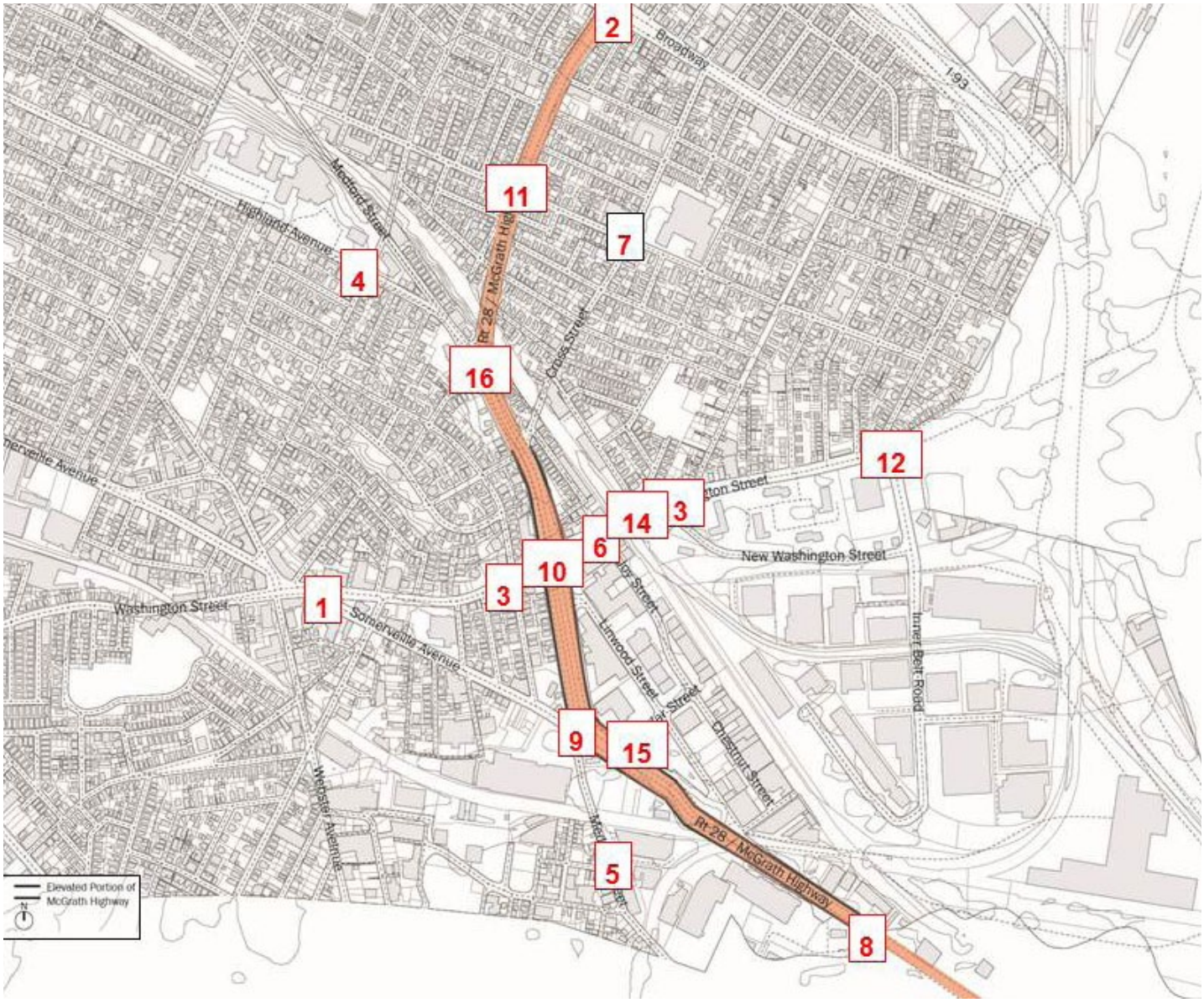


Figure 2-15 : Primary Crossing Locations

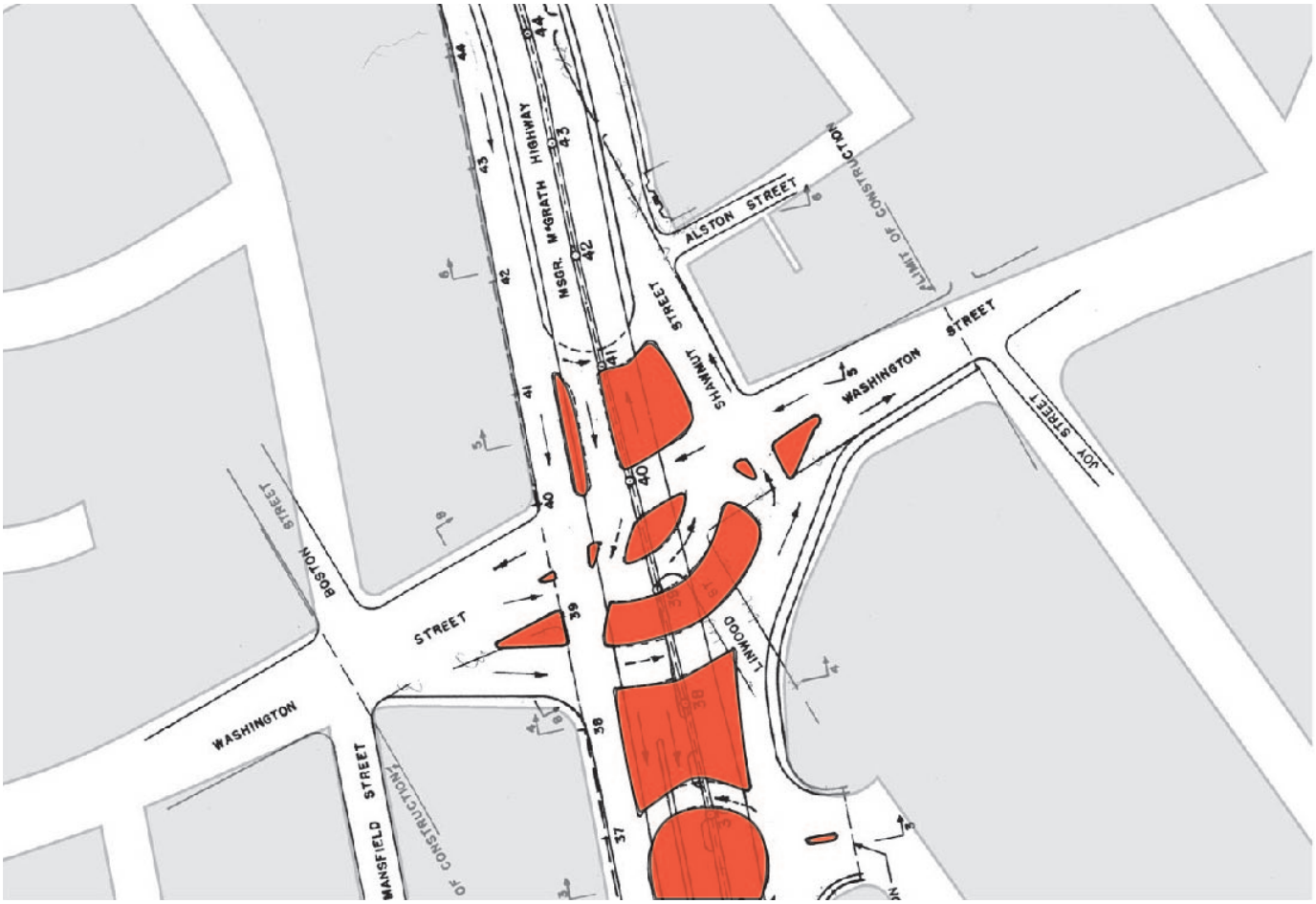


Figure 2-16 : Pedestrian Islands at Washington Street and At-grade McGrath Intersection

the intersection, crossing distances range between 40 and 90 feet. A 7-foot median at Medford Street provides a pedestrian refuge; however, it is too narrow to provide a safe refuge place to break the crossing in two. In addition, an exclusive pedestrian signal phase is provided, encouraging pedestrians to cross both segments of McGrath during a single signal phase. Crossing the McGrath corridor south of Medford Street requires the pedestrian to traverse six lanes of traffic and two turning lanes. MassDOT District 4 recently upgraded the signal heads and restriped the crosswalks at this location in response to concerns from the public.

- At Washington Street: Although the McGrath corridor is elevated at Washington Street, the crossing is difficult due to complicated vehicle circulation and lane channelization, number of conflict points, multiple traffic signals, and many lanes of traffic. This intersection also experiences a higher number of pedestrians than other intersections in the McGrath corridor (See Figure 2-15), as it connects the Union Square and East Somerville neighborhoods. Navigating this intersection is confusing, with multiple “island” stops to get from one side to the other. The lack of pedestrian traffic signals and crosswalks adds to the confusion and delay in crossing. Figure 2-16 highlights the islands in red.

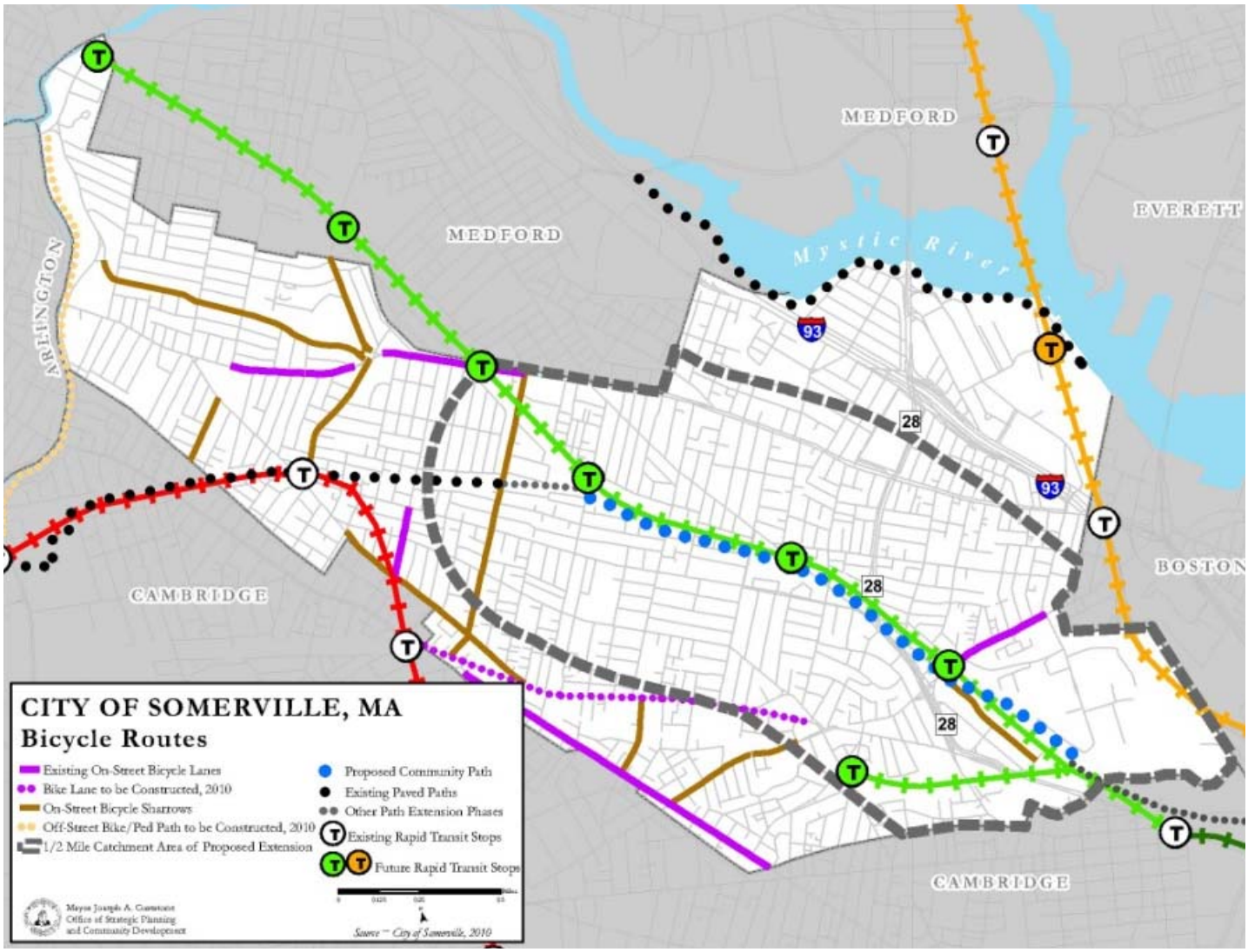


Figure 2-17 : City of Somerville Existing and Proposed Bicycle Facilities

- At Somerville Avenue: Pedestrians must navigate more than 200 feet of pavement to cross the McGrath corridor at Somerville Avenue. Crosswalks at the start of the Grounding McGrath project were faded and existed on only three legs of the intersection. A fourth crosswalk connects Somerville Avenue north to south about 180 feet to the east of the intersection. It should be noted that MassDOT has since improved this intersection with additional pedestrian crossing amenities.

Bicycle Lanes & Markings

The McGrath corridor currently has no bicycle lanes or markings. Although bicyclists are allowed on the McGrath corridor crossing the bridge, high traffic speeds, high traffic volumes, and a lack of specific accommodation make it challenging for even experienced cyclists. The vast majority of cyclists that use the study area roadways do not ride on the McGrath corridor itself, but rather ride on adjacent or crossing routes that have slower traffic speeds, dedicated bicycle lanes, and/or shared lane markings ("sharrows") to indicate the presence of cyclists in the roadway. Cycling along the elevated portion of the corridor carries an additional risk associated with traveling on an elevated roadway with no bicycle lanes, shoulders or other features for the cyclist to use as an escape if forced out of the travel lane by traffic.

Overall, the opportunities for cycling to and across the McGrath corridor are limited, although some cross streets accommodate cyclists with bike lanes or shared lane markings sharrows and others have slower traffic and narrower roadways that are more amenable to cycling. Gilman Street is designated as a "bicycle friendly route"[4] between Cross Street and Walnut Street. Washington Street has bicycle lanes between Tufts Street and Mount Vernon Street. To the south, Somerville Avenue has bicycle lanes from Union Square to Medford Street. Near Lechmere, Cambridge Street has bicycle lanes in East Cambridge and some sharrows over the Monsignor O'Brien Highway Bridge. Parallel roadways, Walnut Street and Cross Street, are designated as "bicycle friendly roads". Walnut Street connects Broadway to Medford Street to Union Square. Cross Street connects from Mystic Avenue to Washington Street via Tufts Street.

The Somerville Community Path currently reaches from Grove Street to Cedar Street in Somerville, and complements the Alewife Linear Park stretching from Davis Square to Alewife MBTA station in Cambridge. The future development section of this chapter provides details regarding the planned extension to the McGrath corridor.

Public Transportation

Buses

The McGrath corridor both carries and is crossed by a number of MBTA bus routes, which provide local service (see Figure 2-18). These bus routes connect the McGrath corridor to local and regional destinations, while also providing connections to Sullivan Square Station (connecting with the Orange Line) or Lechmere Station (connecting with the Green Line).

In the northern section of the study area, MBTA Routes 89 and 101 traverse Broadway in Somerville. Route 89 connects Sullivan Square and Davis Square or Clarendon Hill, while Route 101 traverses Winter Hill in Somerville to serve Medford Square and Malden Center, via Main Street, Salem Street and Pleasant Street.

Routes 80, and 88 serve the local Somerville neighborhoods north of Washington Street, and converge on the McGrath corridor in the vicinity of Medford/ Highland Street continuing to Lechmere. Route 80 parallels the McGrath corridor and the Green Line Extension, providing connections to West Medford and Arlington. Route 88 connects to Davis Square and Clarendon Hill, via Highland Avenue. Route 87 connects at Union Square along Somerville Ave and also continues to Lechmere; it also serves Davis Square and Arlington Center, via Somerville Avenue. Route 90, connects Davis Square and Sullivan Square, via Highland Avenue and travels only within the McGrath corridor to connect to Cross Street to access Broadway.

4 http://www.somervillema.gov/sites/default/files/Somerville%20by%20bike%20ltr.pdf

Washington Street carries significant bus traffic, providing a direct link between Union Square and Sullivan Square. Routes 86 and 91, and CT-2 (providing limited stop weekday cross-town service) all converge in Union Square and provide parallel service across the McGrath corridor .

Table 2-1 shows the bus routes that directly serve the study area, and includes information on frequency and daily ridership.

Buses operate on the surface streets to the extent possible, and must use the Squire's Bridge and the Lowell Line Bridge. Buses do not use the McCarthy Viaduct. There are also numerous stops along the McGrath corridor, including some with a bus shelter. Stops on the routes that bisect the McGrath corridor using Broadway and Washington Street tend to be close to the McGrath corridor, to permit transfers between routes. However, the identified pedestrian access issues along the corridor may inhibit non-transfer uses of these bus stops. Union Square and the adjacent corridor neighborhoods all have direct service; while the Inner Belt and Brickbottom areas are served along the periphery of either Washington Street or the McGrath corridor.

Commuter Rail Lines

The Fitchburg and Lowell MBTA Commuter Rail Lines run through the study area, connecting North Station to and from the north. There are no commuter rail stations within the study area.

Table 2-1: McGrath Corridor Bus Route Headways and Ridership

Route	From	To	Via	Peak Frequency Headway (minutes)	Daily Ridership	Total Daily Ridership at stops within McGrath Corridor
80	Arlington Center	Lechmere	McGrath corridor	20	1,872	324
86	Sullivan Square	Cleveland Circle	Washington St	17	5,139	127
87	Clarendon Hill	Lechmere	O'Brien Highway	18	3,373	132
88	Clarendon Hill	Lechmere	O'Brien Highway	18	3,785	464
90	Davis Square	Wellington	Broadway	35	920	20
91	Sullivan Square	Central Square	Washington St	30	1,482	98
CT2	Sullivan Square	Kendall MIT	Washington St	23	857	170

MBTA Green Line

Green Line trolley service is provided from Boston starting from Government Center or Park Street stations, with service running westward on four branches or north to Lechmere station in East Cambridge at the southern end of the Grounding McGrath study area. As mentioned in Chapter 1, the planned MBTA Green Line Extension (GLX) will extend the Green Line north from a relocated Lechmere station to Union Square in Somerville and College Avenue in Medford. The Squire's Bridge and the Lowell Line Bridge carry the McGrath corridor over the proposed GLX. The future development section of this chapter provides details regarding the planned extension within the McGrath corridor. The project has begun preliminary construction of initial improvements and is in the final design stage.

See Figure 2-18 for the existing and planned transit service.

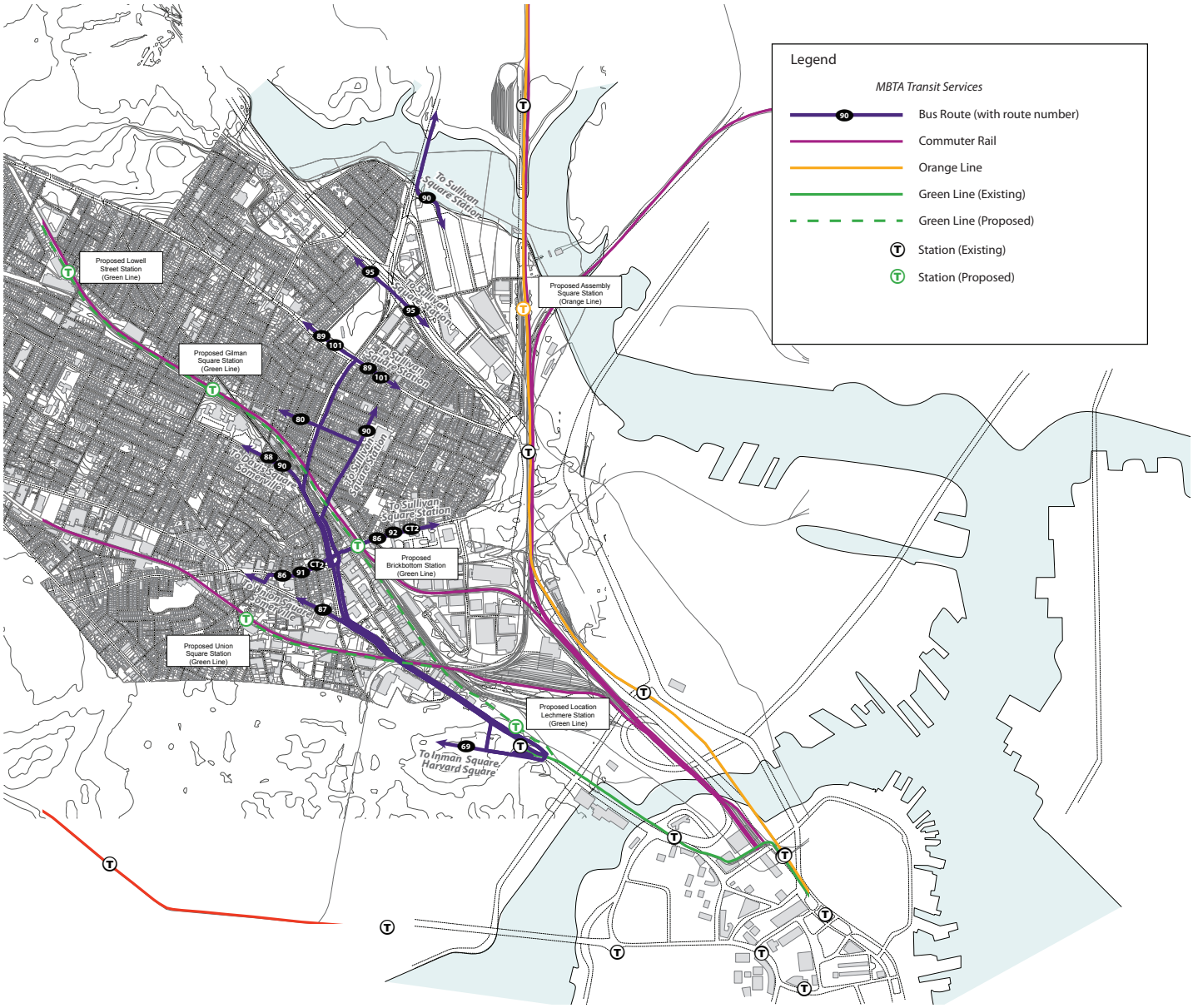
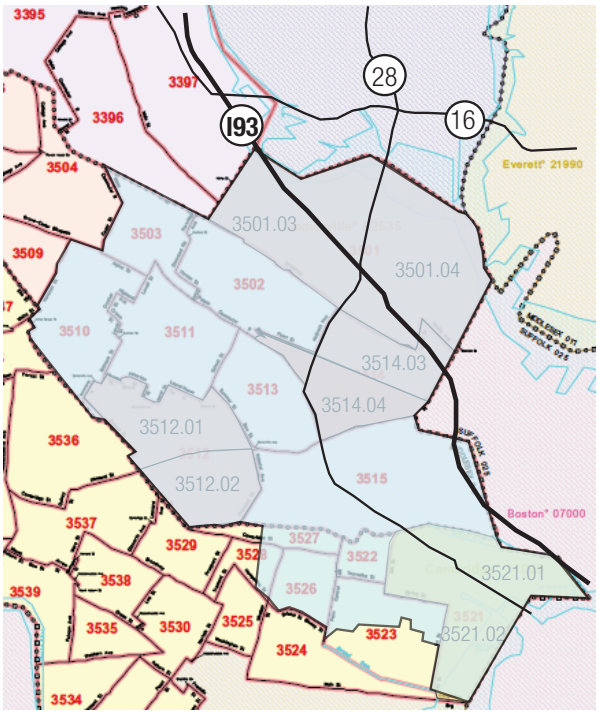


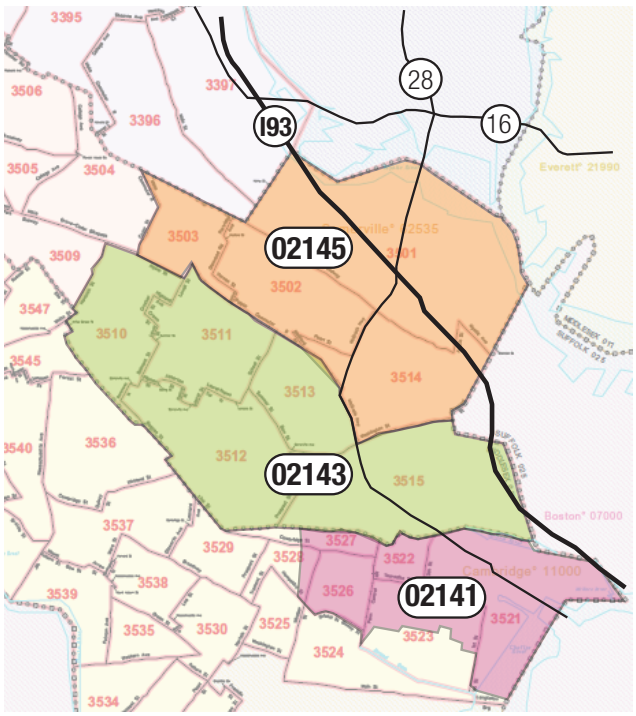
Figure 2-18 : Existing and Planned Transit Service in the McGrath Corridor

Figure 2-19 : Topography in the McGrath Corridor Study Area

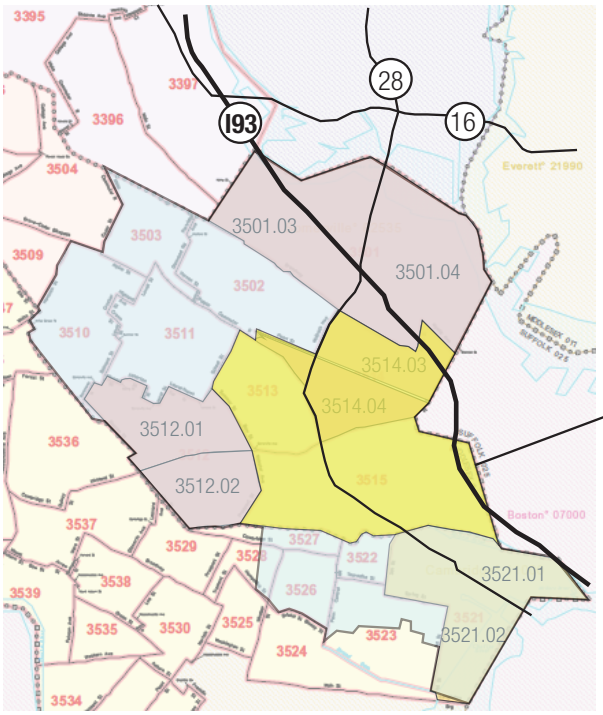
1. "Corridor Area" - Census Tracts for demographic info



2. Zip Codes for business info



3. "Corridor" and "Focus Area" for demographics



City	Census Tracts 1990 - 2000	Census Tracts 2010	Zip Codes
Somerville	3501	3501.03	02145
		3501.04	02145
	3502	3502	02145
	3503	3503	02145
	3511	3511	02143
	3512	3512.01	02143
		3512.02	02143
Focus Area	3513	3513	02143
	3514	3514.03	02145
		3514.04	02145
	3515	3515	02143
Cambridge	3521	3521.01	02141
		3521.02	02141
	3522	3522	02141
	3526	3526	02141
	3527	3527	02141

Map Source: 1990 U.S. Census

Figure 2-20 : Corridor Census Tracts, Figure 2-21 : Study Area Zip codes, Figure 2-22 : Focus Area for Demographics

Demographics and Land Use

The de-elevation of the McGrath corridor through Somerville and Cambridge presents an opportunity to benefit the local businesses and employers and serve a residential neighborhood growing in population, diversity, educational achievement, and housing ownership. The following analysis is intended to identify the underlying demographic and market attributes available to the City, property owners, residents, merchants, and the local development community.

For the purposes of this analysis, the McGrath study area is defined by 16 census tracts, 11 in Somerville and 5 in Cambridge (See Figure 2-20). This area is also covered by three zip codes: 02141, 02143, and 02145 (See Figure 2-21). The study area contains several neighborhoods, including Prospect Hill, East Somerville, Winter Hill, Ward Two, and parts of Industrial Park and the Inner Belt / Brickbottom district. In order to determine the closest and most appropriate area of impact of the de-elevation work, a smaller focus area has been defined, made up of four Somerville census tracts: 3513, 3514.03, 3514.04, and 3515 (See Figure 2-22). This focus area is defined by the Somerville/Cambridge border to the south, the Charlestown border to the east, Prospect, Summer, and School Streets to the west, and Pearl Street, Broadway, and Myrtle Avenues to the north. The population, housing, and business studies were conducted using the US Census, the American Community Survey, and the 2008 Economic Census. The market analysis was done based on recent sales and current listings on the online resources of Trulia and Zillow.

Population

Population in the McGrath corridor has grown slightly over the past 20 years and has been rapidly changing in terms of diversity.[5] The census tract boundaries in the overall corridor (11 in Somerville and 5 in Cambridge) have changed slightly in their definition between the 1990 census and the 2010 census. Figure 2-23 shows the census tracts used for analysis with those in blue representing the larger study area, and those in red covering the focus area between the Lowell Line and Squire's bridges.

In 2010, the population of the study area was 56,560 residents, with 14,860 in the focus area alone. Between 1990 and 2010, the overall corridor population grew 3.6 percent, while the focus area grew by 4.1 percent. During this same period, Somerville lost 1 percent of its overall population, while Cambridge's overall population increased by 9 percent. Population in both the corridor and focus areas has been diversifying rapidly. The White population declined from 88 percent to 64 percent. The diversity has been spread amongst ethnic groups, with growth in the Black, Asian, and Hispanic populations in the area. The Hispanic population in particular has risen from 2 percent of the total population to 13.9 percent since 1990.

The population of people on both ends of the age spectrum has been declining as the numbers of the youngest (0-18 years old) and oldest (65 and older) residents have decreased. Meanwhile, working age cohorts of the population are growing. On a corridor basis, the educational attainment of the population has also shifted as residents with less than a high school diploma declined from 31 percent to 16 percent, and those population cohorts with a bachelor's degree or a graduate degree each increased by 65 percent. On an income basis, corridor median household income in was $59,757 in 2010 – 100% of the state average.

A large portion of Somerville includes Environmental Justice (EJ) population areas designated by the Massachusetts Executive Office of Energy and Environmental Affairs based on factors related to household income and minority populations.[6] For the purpose of this study, an EJ area is defined by the criteria in the Boston MPO's regional equity program (low income and minority population). The McGrath corridor bisects many EJ communities and neighborhoods,

5 Source: 1990, 2000, 2010 US Census; 2009 American Community Survey, 5-year estimate. Race and household information for 2000 and 2010 are referenced from the 2010 PL94 redistricting data

6 http://www.somervillema.gov/sites/default/files/documents/D%20Tran.%20%26%20Infra.%20Final.pdf

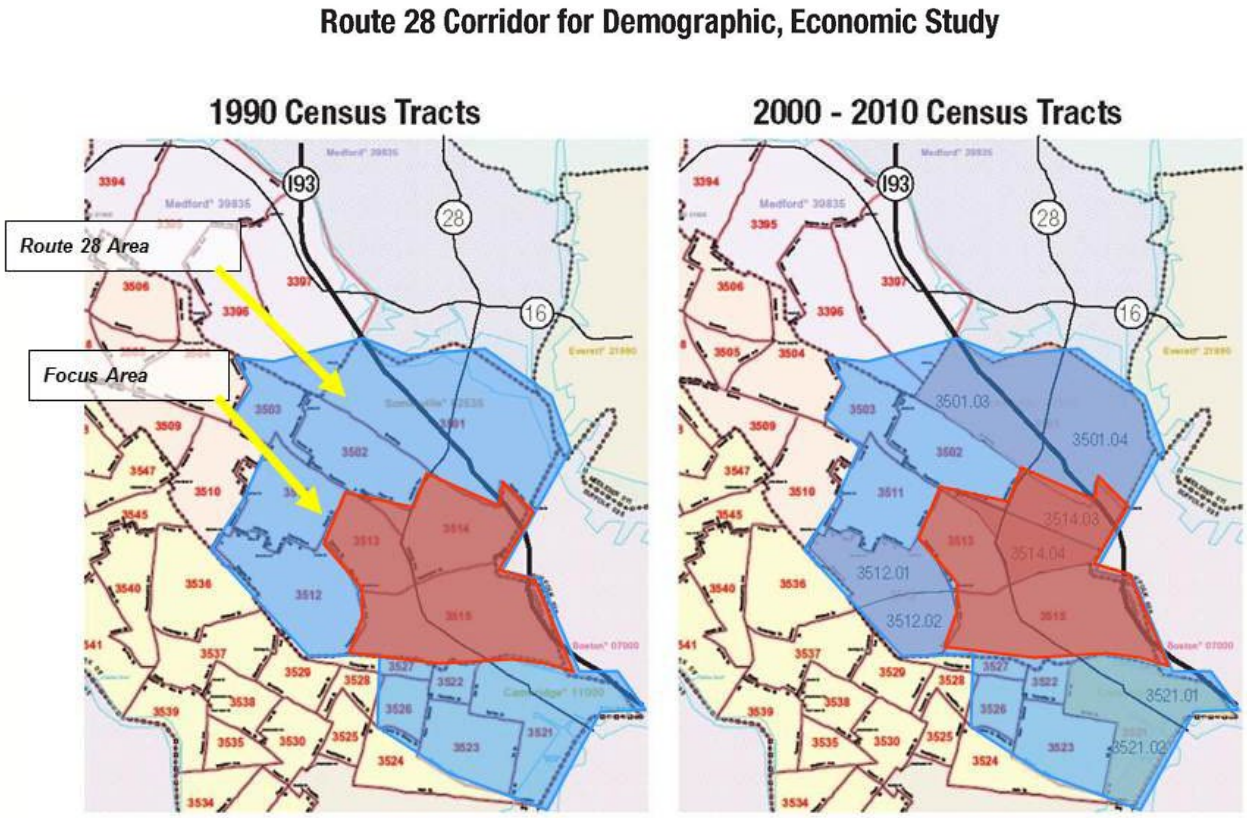


Figure 2-23 : Census Tracts Comparison 1990-2010

- 1,300 establishments
- 23,000 employees
- $983 M in Payroll
- Business size clustered in 1-50 employee cohort (80% of firms in these cohorts)
- Concentrated in FIRE Sector

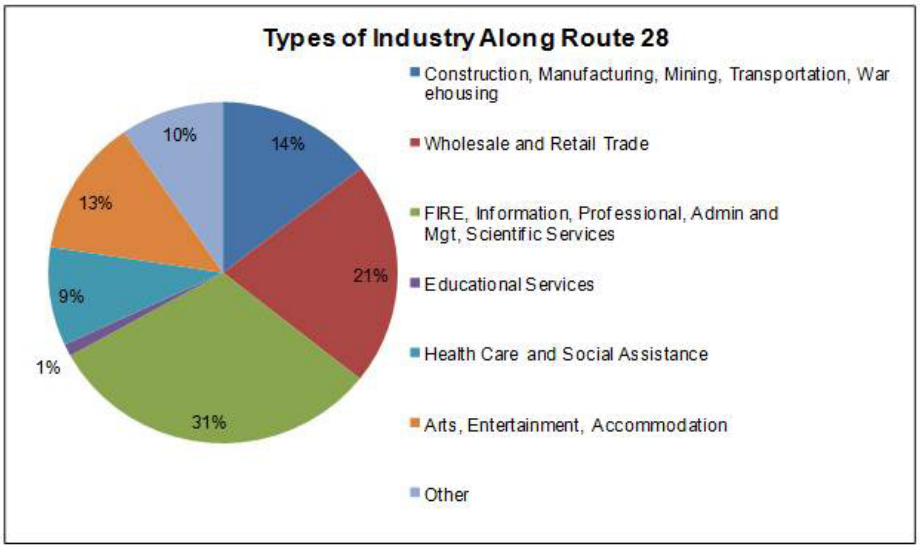
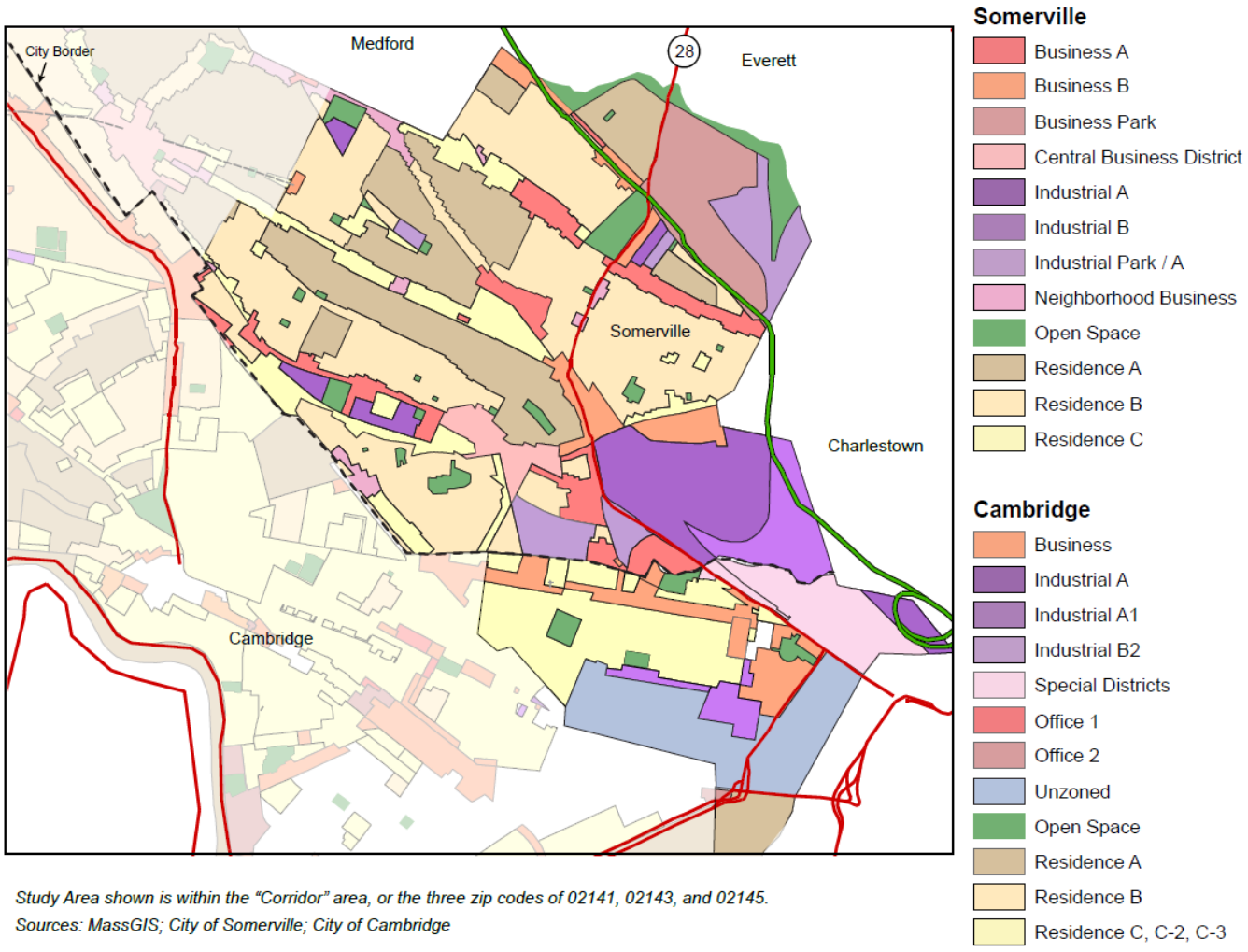


Figure 2-24 : Types of Industry Along the McGrath Corridor



Study Area shown is within the "Corridor" area, or the three zip codes of 02141, 02143, and 02145.
Sources: MassGIS; City of Somerville; City of Cambridge

Figure 2-25 : Zoning Along the McGrath corridor

especially in East Somerville, affecting the quality of life of those who live near or directly adjacent to the elevated structure. This Grounding McGrath study includes a separate environmental justice analysis conducted by CTPS, described in Chapter 5 – Alternatives Analysis. The analysis takes into account air quality, mobility, and accessible factors and their effects on both the EJ and non-EJ populations adjacent to the corridor and prioritizes alternative scenarios based on the results of these ratings.

Land Use

Land use directly abutting the McGrath corridor varies, with single family homes, industrial uses, commercial properties and limited retail all fronting the corridor. There are two large retail developments along the corridor at Twin City Plaza in Cambridge and Target Plaza in Somerville.

The McGrath corridor also serves as the boundary between a number of Somerville's neighborhoods, which are principally residential with some local storefront retail. North of the Lowell Line Bridge, East Somerville begins at the McGrath corridor and continues to the Boston city line. Winter Hill meanwhile runs up to the west side of the McGrath corridor. Prospect Hill slopes down to the McGrath corridor south of the Lowell Line tracks and Highland Avenue. The Ward 2 neighborhood fills in the area around Union Square and runs up against the corridor.

Nearby Union Square is a neighborhood center with local shops, restaurants and other services. Washington Street has limited retail between the McGrath corridor and Sullivan Square. The adjacent Brickbottom area, between the McGrath corridor and the Lowell Line tracks is primarily industrial, although it does have the Brickbottom Lofts residential development. The Inner Belt area, located south of Washington Street between the Lowell Line tracks and I-93, is even more industrial, with larger parcels and industrial establishments. In Cambridge, the area around Lechmere Station is occupied by NorthPoint, a dense mixed-use development of residential, office, retail, and other uses that are currently in the process of being built out on former industrial and rail property. To the west of NorthPoint is the Cambridgeside area, with retail and office uses, as well as the residential neighborhood of East Cambridge.

A review of the types of business establishments and industry along the McGrath corridor was completed as well. There are a total of over 1,300 commercial establishments in the study area that employ approximately 23,000 persons. The majority (80%) of the firms identified (over 1,000) employ between 1 and 50 people. In total, the 23,000 employees represent a cumulative annual payroll of $983 million in the study area. The largest percentages of businesses are in the FIRE (Finance, Insurance, Real Estate) sector, with Figure 2-24 showing the type of industry in the study area by percentage.

Zoning

Current zoning along the McGrath corridor varies along the corridor. Although residential zoning is scattered throughout the McGrath corridor, generally residential zoning is clustered at the northern portion of the study area, north of Washington Street. South of the Gilman Street Bridge, large portions are dedicated and zoned as business and central business district. The southern portion of the McGrath corridor generally has fewer residential areas and contains more business and industrial uses. The southeast portion of McGrath is largely zoned as an industrial area with small portions of business zoning. See Figure 2-25 for zoning districts.

Property Values and Tax Revenue

To determine the future impact of potentially de-elevating the McGrath corridor between Somerville Avenue and Washington Street, property assessments and tax liabilities were identified in the immediate area. Smaller than the "Focus Area," this 56-acre "Impact Area" is bounded by Dell Street to the north, Bonner Avenue and Allen Street to the west, the Fitchburg commuter line to the south, and Poplar Street and the Lowell commuter line to the east. The Inner Belt and Brickbottom neighborhoods lie immediately east of the "Impact Area." With a mix of dense residential and low-

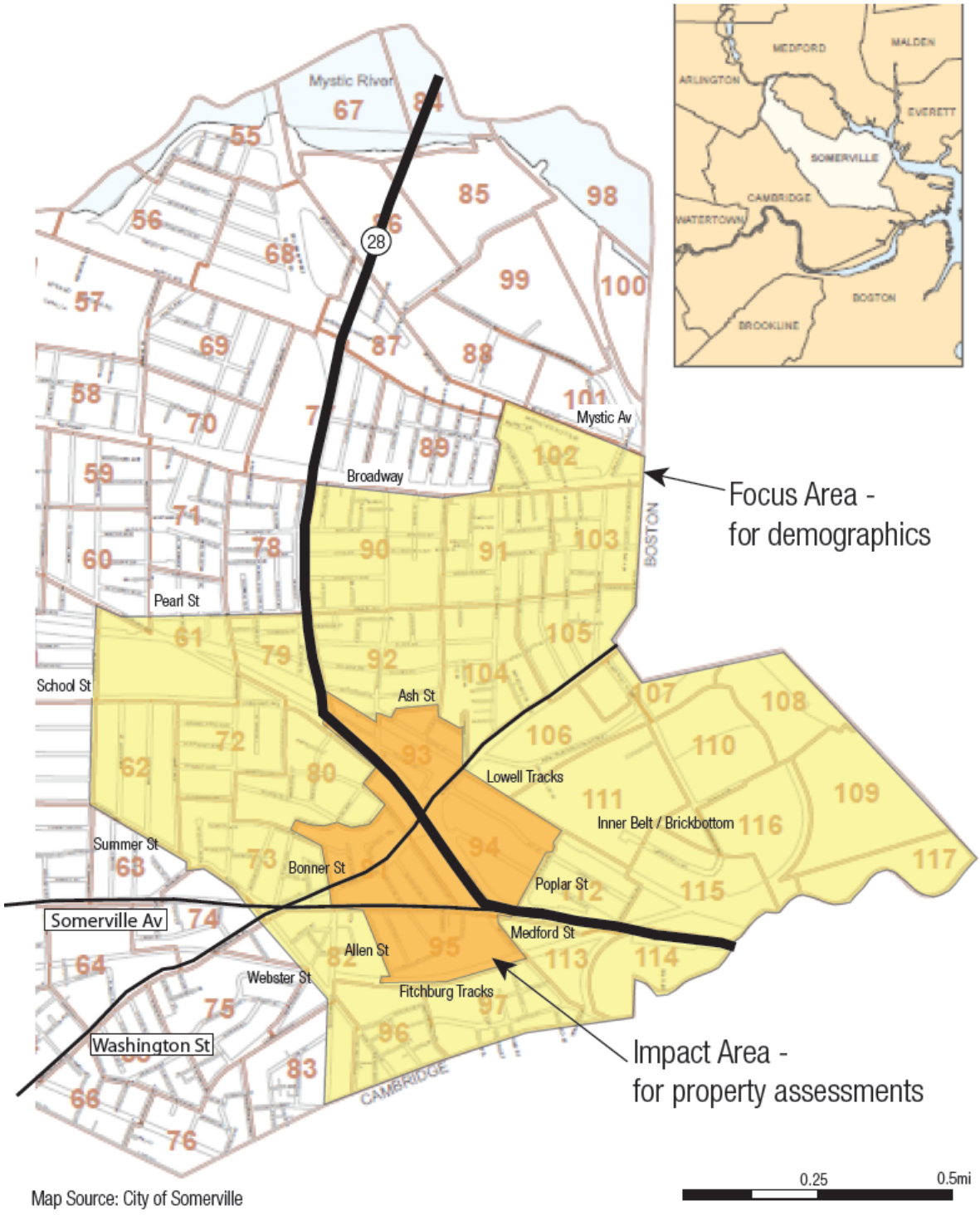


Figure 2-26: Impact Area

density commercial uses like garages and auto services, the aggregate property value in this area is assessed at $190 million, and represents $2.5 million of unadjusted tax liability to the city of Somerville.

Trend Analysis

An initial trend analysis was also completed on the economics of the study area. It should be noted that the city of Somerville's Inner Belt/Brickbottom study is completing a more detailed study of the development economics of those areas to understand the types of development most viable for the revitalization of those neighborhoods. While the Grounding McGrath overall results and analysis are being coordinated with that effort, the initial analysis shows the following:

Housing

The general study area makes up a significant portion of the eastern half of Somerville. Within the focus area, the population has been reasonably stable over the past 20 years, with approximately 14,860 residents in 6,557 households. The median household income is $48,481, below the state-wide median household income of $64,496. Housing production rose by 11 percent between 1990 and 2010, and by 6.4 percent in the focus area, as compared to the Commonwealth's overall housing supply increase of 14 percent.

Of the approximately 6,557 dwelling units in the focus area in Somerville, 6,249 units, or 95.7 percent, are occupied, a rate that is higher than the general area of Somerville of 91 percent. Compared to the Commonwealth of Massachusetts, the general occupancy rate of the focus area has consistently been lower than the larger study areas in Somerville and Cambridge, rising from 91 percent in 1990 to 94 percent in 2000 and back down to 91 percent in 2010. The focus area also exhibits a strong growth rate in owner-occupied units as compared to renter-occupied units: owner-occupied units represent 34 percent of the focus area and 35 percent of the general study area, a 22 percent increase since 1990 levels of 28 percent ownership. The Commonwealth of Massachusetts, for comparison, has had a generally higher rate of ownership, but a slower rate of growth of 2 percent since 1990.

Residential – Rental

- According to the census, for renter-occupied households, median gross rent rose at a steady pace in the last twenty years: by 35 percent between 1990 and 2000, and by 38 percent between 2000 and 2009.
- Market rents in buildings profiled in the study range from $1.15 to $2.25 per square foot, but are clustered around $1.20 to $1.50 per square foot, or $1,600 to $2,000 per month, for a typical two-bedroom unit.
- Mezzo Design Lofts a new, professionally managed apartment building near the focus area has higher rents, in the $2.50 - $2.80 per square foot range.

Residential – For-Sale

- According to the census, the median value of owner-occupied households rose 13 percent between 1990 and 2000, and by 90 percent between 2000 and 2009.
- In East Somerville and its neighborhoods, among 66 recent transactions dating back to summer 2010, sales average $170 per square foot for single-family homes, $130 for multi-family homes, and $303 for condos.
- Per neighborhood, the average per square foot (psf) prices are as follows:
  - East Somerville - $176 psf
  - Prospect Hill - $228 psf
  - Ward Two - $265 psf
  - Winter Hill - $195 psf

These trends represent relatively current market conditions, while the Inner Belt/Brickbottom study will also look at longer term trends. The analysis further shows that the areas of greatest potential for economic development, that is those with the lowest population and highest employment densities are the areas currently under investigation in that effort, as shown in the Figure 2-27 and Figure 2-28.

Development

The City of Somerville is currently investing in the redevelopment in various industrial districts and neighborhoods aligned along the McGrath corridor.

The Grounding McGrath study builds upon and coordinates with the work of several parallel and previous efforts. These inform the existing and future conditions evaluated, influence the goals and measures developed, and must work in tandem with the alternatives developed. Within the project study area, there are a number of infrastructure projects and adjacent development districts already being studied, as indicated in Figure 2 - 29. These areas are being revitalized in conjunction with the anticipation of the Green Line Extension (GLX) and include projects such as the Assembly Square, Union Square, and Inner Belt Brickbottom Districts as well as the extension of the Somerville Community Path. The Grounding McGrath Study's proposed alternatives will strive to better connect these developments, create economic opportunities for the city, and increase the accessibility of amenities for local residents and visitors.

Green Line Extension (GLX)

As mentioned previously, MassDOT and the Massachusetts Bay Transportation Authority (MBTA) are working jointly on this important project that will extend the MBTA Green Line service from a relocated Lechmere Station in East Cambridge to Union Square in Somerville on one branch and to College Avenue in Medford on another branch. It will

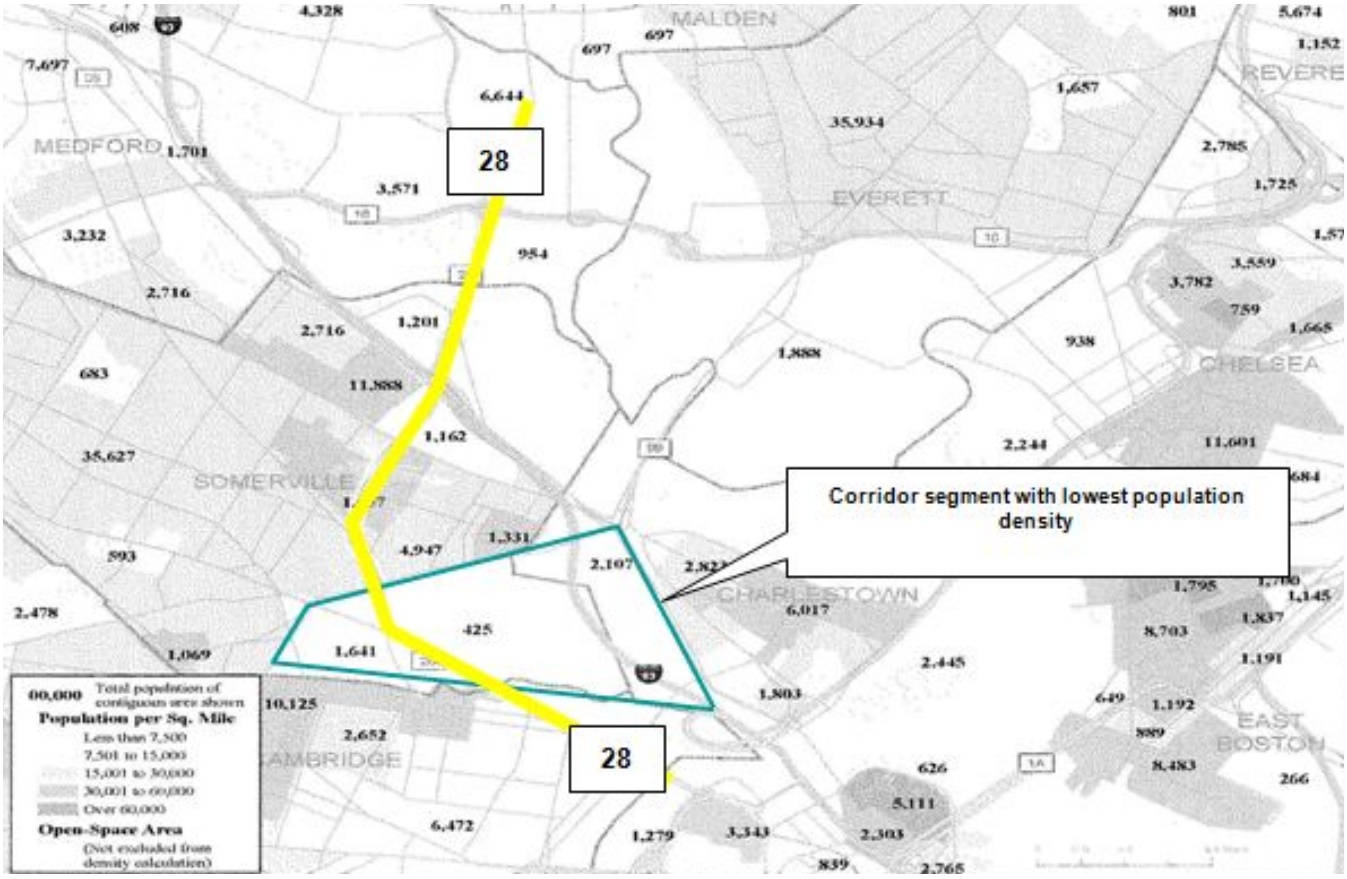


Figure 2-27 : Population Density , 2000 U.S. Census, CTPS *Toward a Route 28 Corridor Transportation Plan*

provide new and better opportunities for residents and visitors to travel within their communities and within the region. The GLX includes a new station at Washington Street directly abutting the study area, as well as a station in Union Square.

The Washington Street station, which will be on the Medford Hillside branch, will be located just east of the McGrath corridor at the corner of Washington Street near Brickbottom. The station would be on the elevated railroad abutment and extend south from Washington Street towards Poplar Street. The City of Somerville is working closely with the MBTA on the specifics of the design, and a likely local bus connection on the Inner Belt (east) side of the station. The Brickbottom Station is expected to increase transit use in the area, and create additional pedestrian desire lines and crossings of the McGrath corridor.

Lechmere Station – the current Green Line terminus with a turnaround along Cambridge Street across from First Street and Second Streets – will be relocated from the west side to the east side of the McGrath corridor. This relocation is necessary for the extension to proceed along the existing Lowell and Fitchburg commuter rail right-of-ways. Design of the new station is being coordinated with the city of Cambridge and the surrounding NorthPoint development.

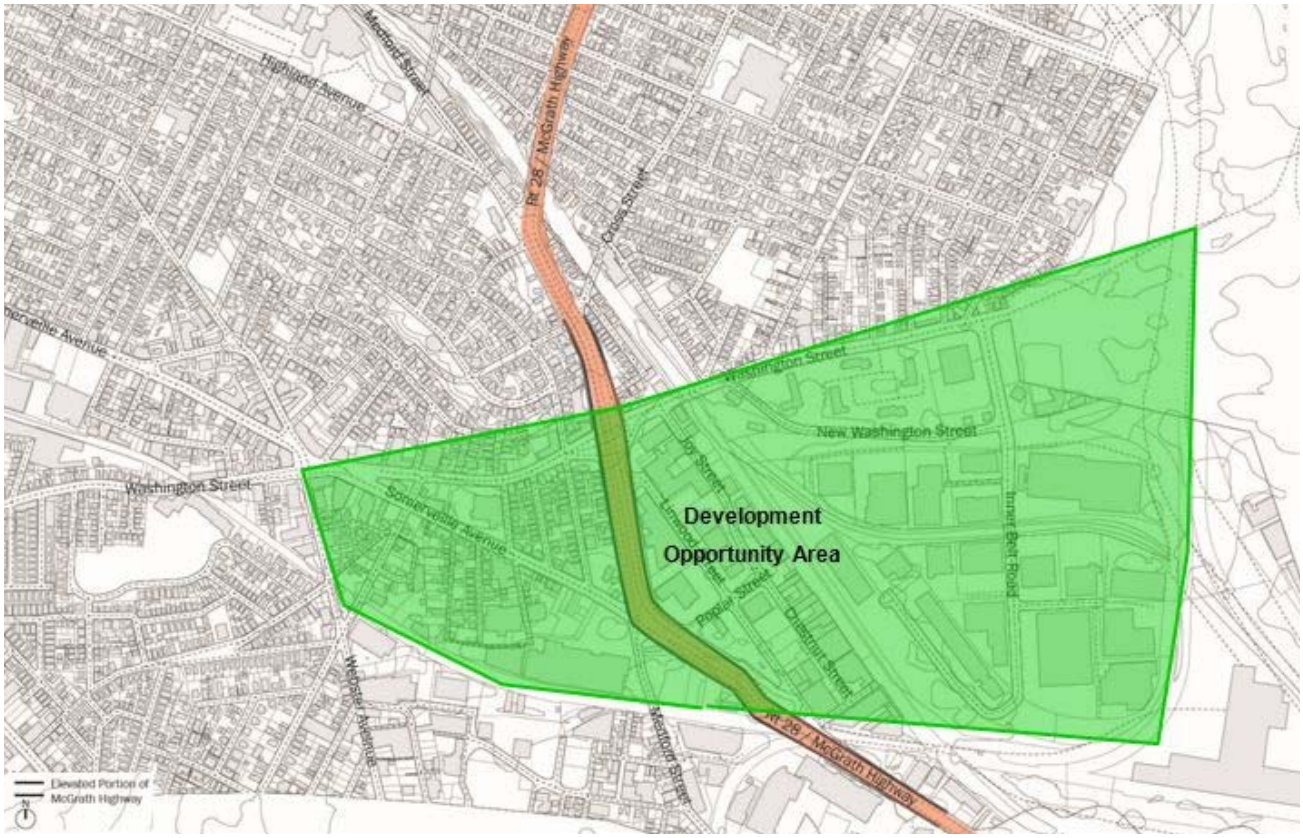


Figure 2-28 : Development Opportunity Area

The GLX is seen as a catalyst project for the development and improvement of the areas it will serve. It will provide new and better opportunities for residents and visitors to travel within their communities and within the region. Connections for pedestrians, bicyclists, and buses to these stations are an important consideration in the Grounding McGrath study. The GLX has begun preliminary construction of initial improvements and is in the final design stage.

Brickbottom District

The recommendations of the Grounding McGrath study will have a major effect on the Inner Belt and Brickbottom districts of Somerville. The City of Somerville's Office of Strategic Planning and Community Development (OSPCD) has undertaken a major planning initiative for this area, a 160-acre light industrial zone located in the southeast corner of Somerville adjacent to the McGrath corridor along its western edge. The goal of the redevelopment of Inner Belt/Brickbottom (IBBB) is to expand the land uses of the area and to improve and increase access to the Districts from the rest of

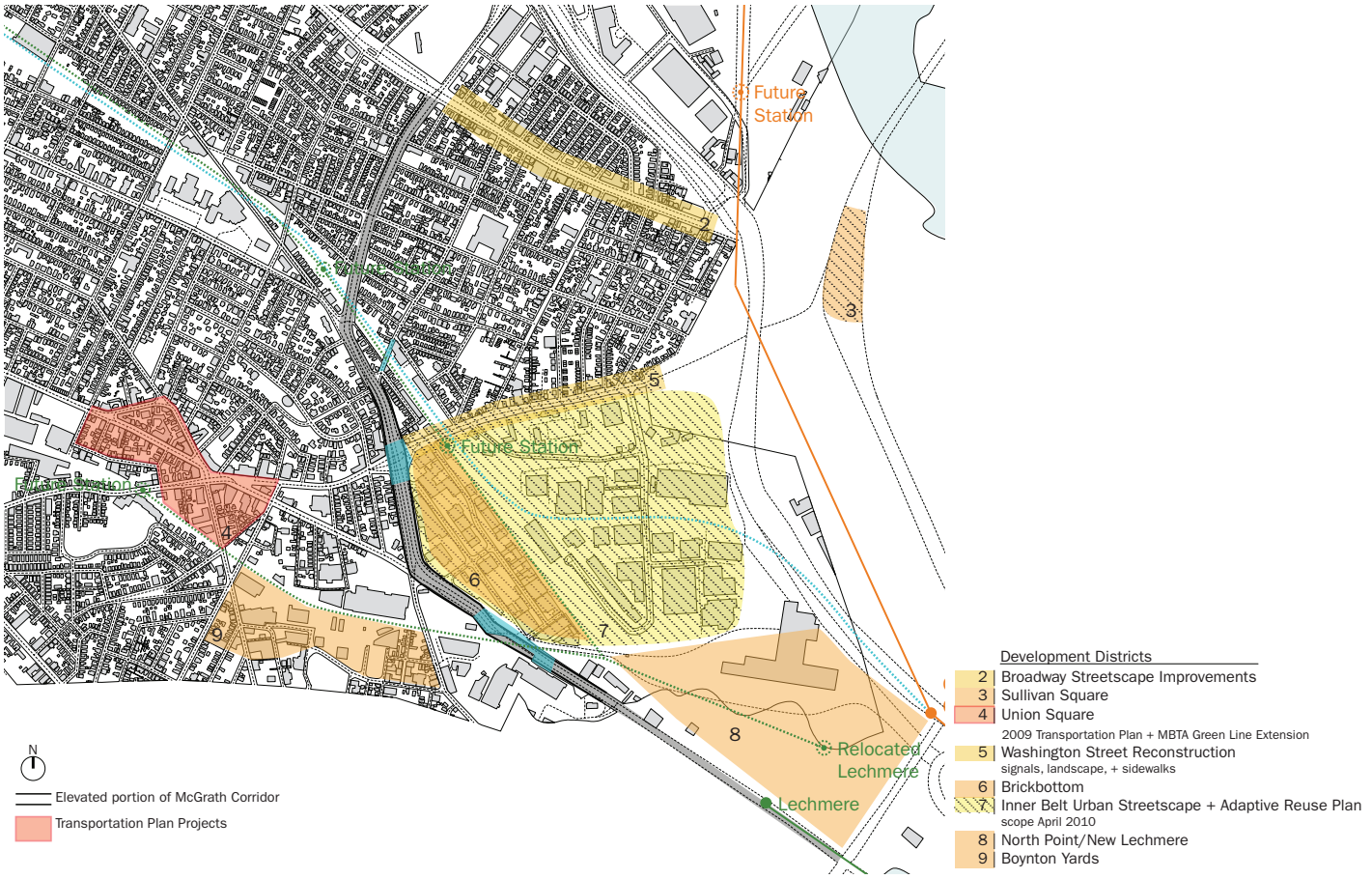


Figure 2-29 : Coordinated Development and Infrastructure

Somerville as well as Boston and Cambridge. The goals of the study seek to create mixed use developments, strengthen and connect transit networks, create open space, and connect to a broader network of accessible districts in Somerville. The land use projections, transportation access issues, and future development of the Green Line station explored through the IBBB Study were incorporated in the Grounding McGrath study. Similarly, this study highlighted opportunities to address broader goals identified in the city's IBBB study.

Somerville Community Path

The extension of the Somerville Community Path would provide an excellent opportunity to improve the quality of life and livability for the city. It would be an extremely important asset for Somerville for a variety of reasons, such as its contributions to local accessibility, regional bicycle and pedestrian connectivity, and promotion of additional transportation options for local residents. There are also numerous public health benefits attributed to a creating more shared-use paths to support active modes of transportation. Supporting active modes of transportation through implementation of the Community Path would help to reduce pollution and improve the environment throughout the densely populated city.

The extension of the Community Path through the McGrath corridor to Cambridge and beyond is both a high priority for Somerville and the region at large. The City of Somerville, the "Friends of the Community Path" and numerous others have been working to provide an ultimate connection between the Minuteman Bikeway and the Charles River path networks. The current Somerville Community Path reaches from Grove Street to Cedar Street in Somerville, and complements the Alewife Linear Park stretching from Davis Square to Alewife MBTA station in Cambridge. The construction on Phase II of the Community Path is anticipated in 2013 and will extend it from Cedar Street to Lowell Street, which will ultimately provide access to the new Lowell Street GLX Station. The final phase of the project will connect Lowell Street to Inner Belt District in Somerville, and design of this portion is being planned in conjunction with the GLX.

The Community Path vision and goals have been ingrained in both the Grounding McGrath study as well as the GLX projects as integral components. In 2006, the Somerville Community Path Feasibility Study identified the McGrath corridor as a major crossing to reach the desired terminus of NorthPoint in Cambridge. The Grounding McGrath study recognizes the importance of providing either a direct connection for the Community Path, as well as the critical need to provide cross connections to the path in whatever alignment is ultimately completed. MassDOT recognizes that the Community Path extension is a significant component in meeting the Commonwealth's GreenDOT initiatives to enhance non-auto mode share, as well as meeting health and environmental goals. Similarly, current designs for the MBTA's GLX include a continuation of the Community Path along the Green Line right-of-way as far south as Innerbelt Road, with associated connections to ground level at Washington Street and Poplar Street. This project realizes the broader multimodal connections and networks that both can help to support in Somerville.

Environmental

The McGrath corridor bisects a dense network of established neighborhoods, as well as commercial and historically industrial areas in Somerville. Environmental concerns associated with the Grounding McGrath study are legitimate given the industrial nature and land uses of the neighborhoods and districts adjacent to the highway. Since the highway was completed in the early 1950's, much of the built environment has also been affected by the combination of traffic volumes, speeds, congestion, and pollution. The project's goals include improving environmental conditions along the corridor, including remediating uncompensated environmental effects from uses outside of the corridor, and improving access and operations of the environmental resources already present in the area.

Open Space/Parkland

The neighborhoods surrounding the McGrath corridor generally have parks and open space available to residents. These open spaces and parkland include neighborhood amenities such as Foss Park, Prospect Hill Park and Senator Corbett Playground. However, as the McGrath corridor is such a pedestrian barrier, access to open space in the adjacent neighborhoods is often practically limited to residents on the side of the corridor where the park is located.

The only open space directly abutting the study area is the Otis Street Playground. This is a City of Somerville-owned and managed playground offering active recreation and play space on a tenth of an acre at the corner of Otis Street and Dana Street, just on the west side of the corridor. A pedestrian bridge, owned by the Department of Conservation and Recreation, connects over the McGrath corridor and provides access from East Somerville to the Otis Street playground.

Just north of the study area, to the west of McGrath, is the largest open space in the area – Foss Park. At 14.62 acres, Foss Park provides one of the largest recreational park space(s) in Somerville. Equipped with multiple ball fields, basketball courts, and play structures it is a popular recreation destination for the surrounding neighborhoods, and is owned and managed by the Massachusetts Department of Conservation and Recreation. Pedestrian access to Foss Park from East Somerville is significantly encumbered by dangerous crossings at McGrath and Broadway.
Table 2-2 depicts a brief description of the parks and open space within relatively close proximity to the McGrath corridor by neighborhood, while Figure 2-30 shows the locations.

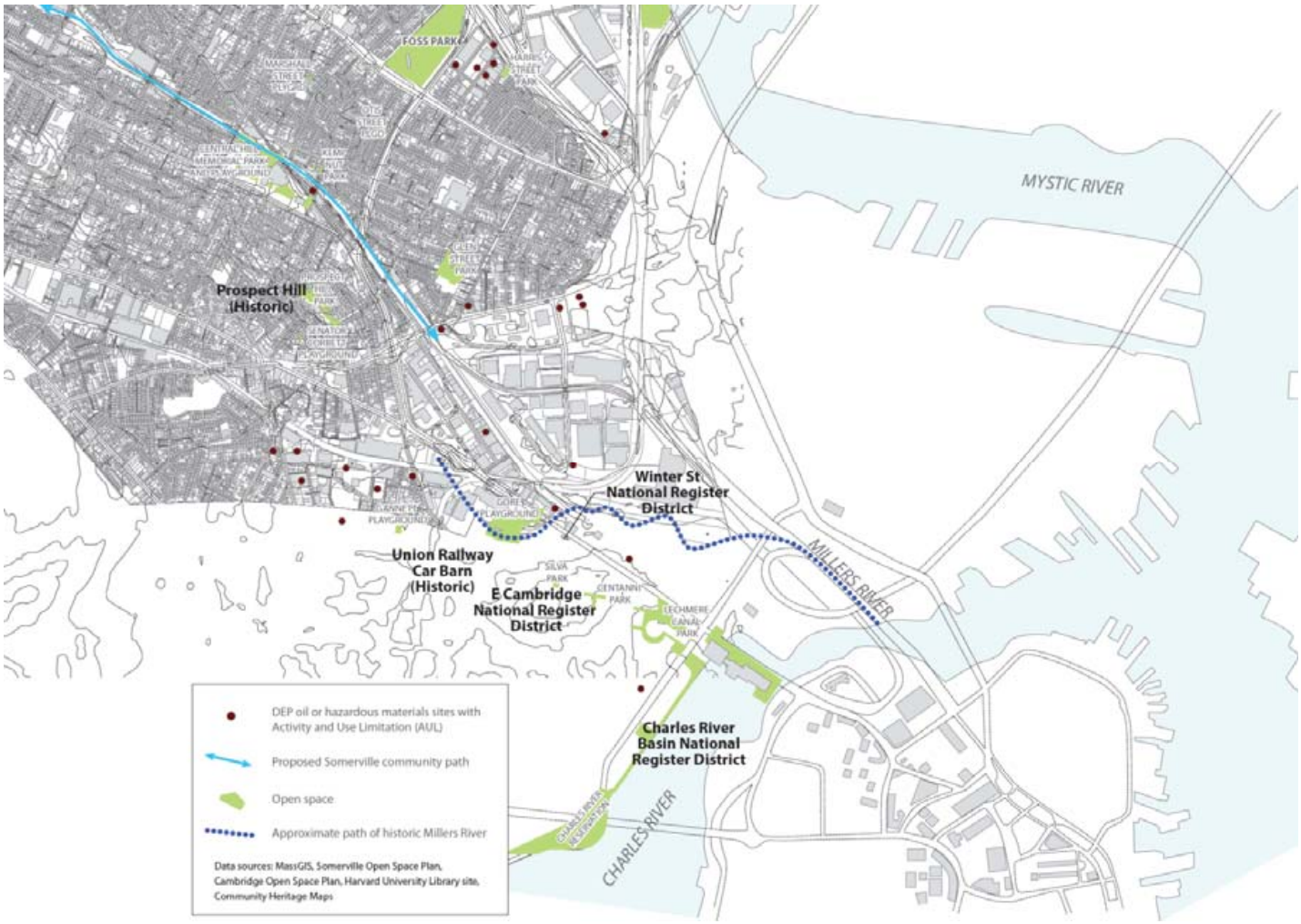


Figure 2-30 : Somerville Environmental Map

Table 2-2: Somerville Open Space and Parks by Neighborhood

East Somerville			
Park/Open Space	**Size**	**Streets**	**Ownership**
Edgerly Education Center	0.10 acres	Bonair Street/Cross Street	Somerville
East Somerville Community School	1.40 acres	Cross Street/Pearl Street	Somerville
Glen Park /Capuano Field	2.34 acres	Glen Street/Oliver Street	Somerville

Prospect Hill			
Park/Open Space	**Size**	**Streets**	**Ownership**
Central Hill Park	8.94 acres	Highland Avenue	Somerville
Central Library Lawn	0.61 acres	Highland Avenue/ Walnut Street	Somerville
Corbett-McKenna Park	0.61 acres	Munroe Street/ Prospect Hill Avenue	Somerville
Prospect Hill Park	2.10 acres	Prospect Hill Avenue	Somerville

Ten Hills			
Park/Open Space	**Size**	**Streets**	**Ownership**
Foss Park	14.62 acres	Broadway/McGrath corridor	DCR

Union Square/Beacon Street			
Park/Open Space	**Size**	**Streets**	**Ownership**
30 Allen Street Park and Garden	0.13 acres	Allen Street	Somerville
111 South Street OLRA	0.36 acres	South Street/Windsor Street	Somerville

Winter Hill			
Park/Open Space	**Size**	**Streets**	**Ownership**
Otis Street Playground	0.10 acres	Otis Street/McGrath corridor	Somerville
Edward W. Leathers Community Park	0.71 acres	Walnut Street/Gilman Street	Somerville

East Cambridge			
Park/Open Space	**Size**	**Streets**	**Ownership**
Centanni Way	0.30 acres	Third Street/Otis Street	Cambridge
Gold Star Mothers Park	3.6 acres	Gore Street/Sixth Street	Cambridge
Lindstrom Field	1.4 acres	Brookline Street/ Granite Street	Cambridge
Silva Park	0.30 acres	Otis Street/Sciarappa Street	Cambridge
Simoni Memorial Rink	n/a	Gore Street/Sixth Street	DCR

Wetlands/Water & Sewer/Flooding

A review of information available from MassGIS was completed to assess the extent to which wetlands are present within

the study area. As with much of the area around Boston Harbor, parts of this area are built on fill as marshes and tidal river areas were filled in the 19th century as the area industrialized. According to the Massachusetts Department of Environmental Protection (DEP), no wetlands are currently registered within the study area that would pose any obstacle or constraint to the redevelopment of the McGrath corridor.

The only historic waterway of note is the Millers River (or Willis Creek), a small flow along the southern border of Cambridge and Somerville that has long been piped, infilled, and channeled for industrial activity. The Millers River is a tributary to the Charles River. The water is drained through underground culverts with the exception of a small segment near the junction with the Charles River. It should be noted that during significant storm events, flooding from the Millers River and sewer overflow can be evidenced in lower portions of the study area, especially near the Somerville Avenue and Poplar Street intersections with the McGrath corridor.

The Mystic River borders Somerville to the north, and the Charles River runs to the east of Lechmere. The Charles River to the south and Mystic River to the east lie well beyond the scope of this project.

The MassDOT Highway Division is utilizing Best Management Practices (BMP) to improve stormwater management through both a retrofit and programmed projects initiative, particularly for older urban arterials such as the McGrath corridor.[7]

Air Quality

Specific information on the air quality directly adjacent to the McGrath corridor is not readily available. For planning purposes, air quality on a regional level is measured and available as part of the CTPS regional travel demand model. It is understood that air quality concerns are paramount for the abutting neighborhoods surrounding the McGrath corridor due to the heavy traffic volumes and congested intersections along the corridor. Moreover, because of the subsequent high levels of air pollutants in the immediate vicinity, those living in close proximity to the McGrath corridor are at higher risk for respiratory diseases and other health risks.

Daily traffic volumes and intersection congestion on the McGrath corridor are significant. Using both traffic micro-simulation and regional travel demand modeling, the Grounding McGrath study effort catalogued estimates of emissions for the existing conditions, the 2035 No-Build conditions (discussed in Chapter 3) and for each of the alternatives. For all scenarios, estimated emissions for Carbon Monoxide (CO), Nitrous Oxide (NOx), Volatile Organic Compounds (VOC), Carbon Dioxide (CO2), Particulate Matter 10 microns (PM10) and Fine Particulate Matter (PM2.5) were modeled and documented.

The Health Impact Assessment completed by the Massachusetts Department of Public Health in conjunction with this project also provides an opportunity to review the relationship between air pollutants and public health in a more detailed way.

Noise Levels

Noise levels from highway traffic are affected by three factors: (1) the volume of traffic, (2) the speed of the traffic, and (3) the number of trucks in the flow of traffic. Generally, the loudness of traffic noise is increased by heavier traffic volumes, higher vehicle speeds, and greater numbers of trucks. As with Air Quality, no specific readings of current noise levels along the McGrath corridor are available as of this review.

Vehicular traffic on the McGrath corridor travels on the surface roads and along the elevated structures. Most of the McGrath corridor is surrounded by multi-story buildings. The presence of the elevated structure likely both shields and exacerbates noise from traffic on the directly adjacent neighborhood. Noise is generated by the structure itself as vehicles travel over bridge expansion joints. Similarly noise reflects off the underside of the elevated bridge structure and has the potential to increase noise pollution to neighborhoods and areas close by.

7 *NPDES Phase II Small MS4 General Permit Annual Report*, No. 9, April 2011-March 2012.

Soil and Geologic Features

A review of information made available by the City of Somerville helped to assess the types of soil and geologic features that are present in the study corridor. A majority of the McGrath corridor and adjacent lands are composed of Urban Land, which are areas that have been filled with crushed rock or other material that is resistant to weathering. Buildings, industrial areas, pavement, and railroad beds cover most of these areas and these are known as impervious surfaces.

Archaeological and Cultural Resources

Near the McGrath corridor are several National Register Districts. The Winter Street National Register District in Somerville and the East Cambridge National Register District are both near the southern part of the corridor. Prospect Hill and the surrounding neighborhood abut the northwest portion of the Corridor. Prospect Hill played an important role in the American Revolutionary War and is known as the first place where the first true American Flag representing the united colonies was ever flown.

A review of existing environmental conditions indicates that there are no historic, cultural and archaeological resources affected by the McGrath corridor.

Areas of Critical Environmental Concern

The McGrath corridor does not contain directly abutting Areas of Critical Environmental Concern (ACECs).

Hazardous Materials Sites

The Massachusetts Department of Environmental Protection (DEP) has identified numerous sites that have been categorized Activity and Use Limitations (AUL) for development. The AUL categorization of these properties imposes limits and conditions on their future uses of the property based on identified onsite pollutants. The McGrath corridor right-of-way has been primarily built out and does not include any of these areas per this review. A number of sites within the study area located outside of the roadway have identified AULs and are shown in Figure 2-30. The more prominent sites with AUL's include areas near Stop N Shop/Foss Park, Rufo Road, and the area east of Water Street.

Current Transportation Utilization

Traffic Volumes

In March and May of 2011, both MassDOT and a contractor to the project team conducted traffic counts during weekday morning and weekday afternoon peak periods.[8] The counts completed by MassDOT in March 2011 are in the northern part of the McGrath corridor study area. The traffic data was collected during the Craigie Bridge closure (where Route 28 crosses the Charles River) but a comparison to prior counts indicated that volumes are consistent, and that the bridge closure appeared to have minimal impacts on those locations.

The data consisted of manual turning movement counts (MTMCs) and automatic traffic recordings (ATRs). MTMCs represent the various approach movements (left, through, right) that pass through an intersection over a given period of time. ATRs collect data regarding traffic volumes, speed, and vehicle classification over a period of days or a week.

MassDOT Highway Division provided ATRs for the following locations:

- Ramps and surface roads at the intersection of the McGrath corridor/Somerville Avenue/Medford Street[9]
- Ramps and surface roads at the intersection of the McGrath corridor and Washington Street[10]
- The McGrath corridor over Gilman Street[11]
- The McGrath corridor north of Washington Street[12]

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8 It should be noted the May 2011 counts were conducted after the commencement of construction activities associated with the Craigie Drawbridge. The bridge was re-opened to Boston bound traffic in April 2011.

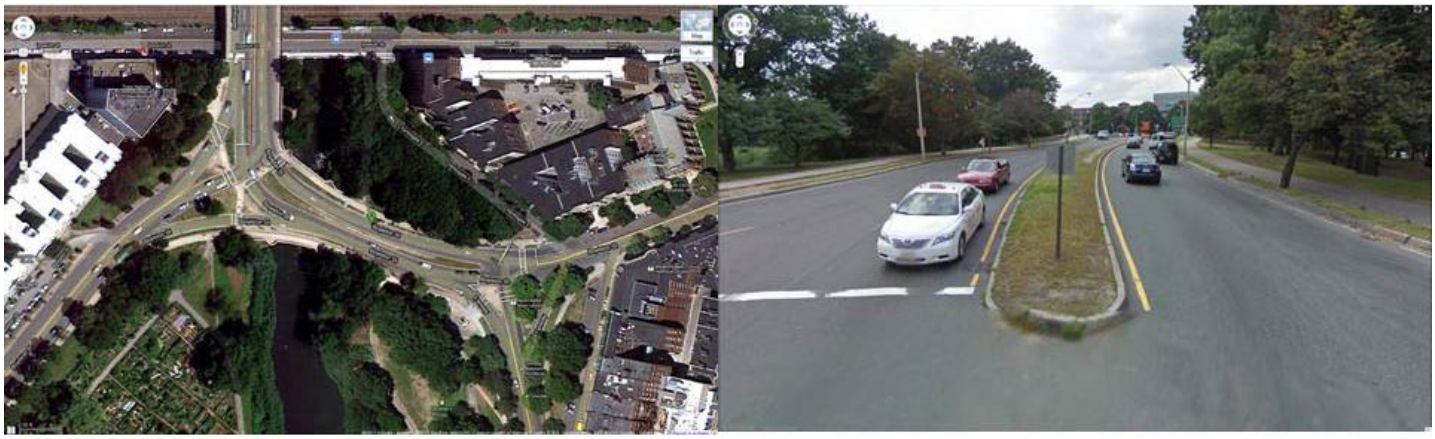
9 Monday, March 28, 2011 to Wednesday, March 30, 2011

10 Monday, March 28, 2011 to Wednesday, March 30, 2011

11 Monday, May 16, 2011 to Thursday, May 19, 2011.

12 Tuesday, August 2, 2011 to Thursday, August 4, 2011

- Boylston between Fenway and Charlesgate Overpass
  - 38,000 at Gilman St (+/-5,000 ADT)



- Cambridge St east of Charles Circle
  - 38,000 at Gilman St (+/-5,000 ADT)

- Melnea Cass Blvd between Tremont St and Shawmut Ave
  - 38,000 at Gilman St (+/-5,000 ADT)

Figure 2-31 : Photos of comparable corridors by ADT in the Boston area

- The McGrath corridor over the railroad tracks at Linwood (Squire's Bridge)[13].

Average Daily Traffic (ADT) can be determined from the ATR data. ADT represents the average number of vehicles that pass over a specific point in the roadway, in either direction, during the course of a 24-hour day. ADT volumes on the McGrath corridor at key points are:

- 38,000 on the Gilman Street Bridge,
- 32,500 over Washington Street (does not include ramps)
- 29,700 on the Squire's Bridge.

An ADT of about 38,000 vehicles is comparable to the following Boston roadways (within about 5,000 vehicles per day). However, it should be noted that these roadways likely do not experience comparable volumes of cross street traffic and therefore may have a different character and operational level than the McGrath corridor:

- Boylston Street between Fenway and Charlesgate Overpass
- Cambridge Street east of Charles Circle
- Melnea Cass Boulevard between Tremont Street and Shawmut Avenue

See Figure 2-31 for photos illustrating the characteristics of these roadways.

Based on available data in the vicinity of Rufo Road at the Somerville/Cambridge line, it is estimated that there has been a 27 percent decrease in traffic on the McGrath corridor since 1987. The ADT from 1987 to 2011 is presented in Figure 2-32. In 2003 traffic decreased and then leveled off, which coincides with the primary opening date of the new Central Artery/Tunnel in Boston. It is assumed that some vehicular traffic that had previously used Route 28 shifted to I-93 when congestion and delays decreased with the completion of the Central Artery/Tunnel project. The potential use of the McGrath corridor as an alternative to I-93 is discussed in a subsequent section.

MassDOT collected MTMCs during the morning and afternoon peak periods[14] at the following intersections with the McGrath corridor:

- Pearl Street[15]
- Medford Street/Highland Avenue[16]
- Somerville Avenue/Medford Street[17]
- Washington Street[18]
- Austin Street/Land Boulevard[19]

MTMCs were collected by the project team at the following intersections with the McGrath corridor[20]:

- Blakeley Avenue
- Broadway
- Poplar Street
- Rufo Road
- Third Street
- Cambridge Street/East Street

Traffic counts from the MTMCs between adjacent intersections were generally consistent, with traffic exiting one intersection matching traffic entering the next intersection within about 10 percent. This match rate is reasonable given the number of side streets and driveways along the McGrath corridor. Therefore, it was not necessary to "balance" (i.e. adjust traffic volumes to ensure consistency) traffic volumes along the corridor with the exception of McGrath corridor links where there is no additional vehicular access between the counted intersections. Locations where traffic volumes were balanced include:

- Blakeley Avenue
- Broadway
- Rufo Road
- Third Street
- Cambridge Street/East Street
- Land Boulevard/Austin Street

13 Tuesday, August 2, 2011 to Thursday, August 4, 2011

14 7:00 AM to 10:00 AM and 4:00 PM to 7:00 PM

15 Tuesday, May, 18, 2011

16 Tuesday, May, 18, 2011

17 Tuesday, March 30, 2011

18 Tuesday, March 30, 2011

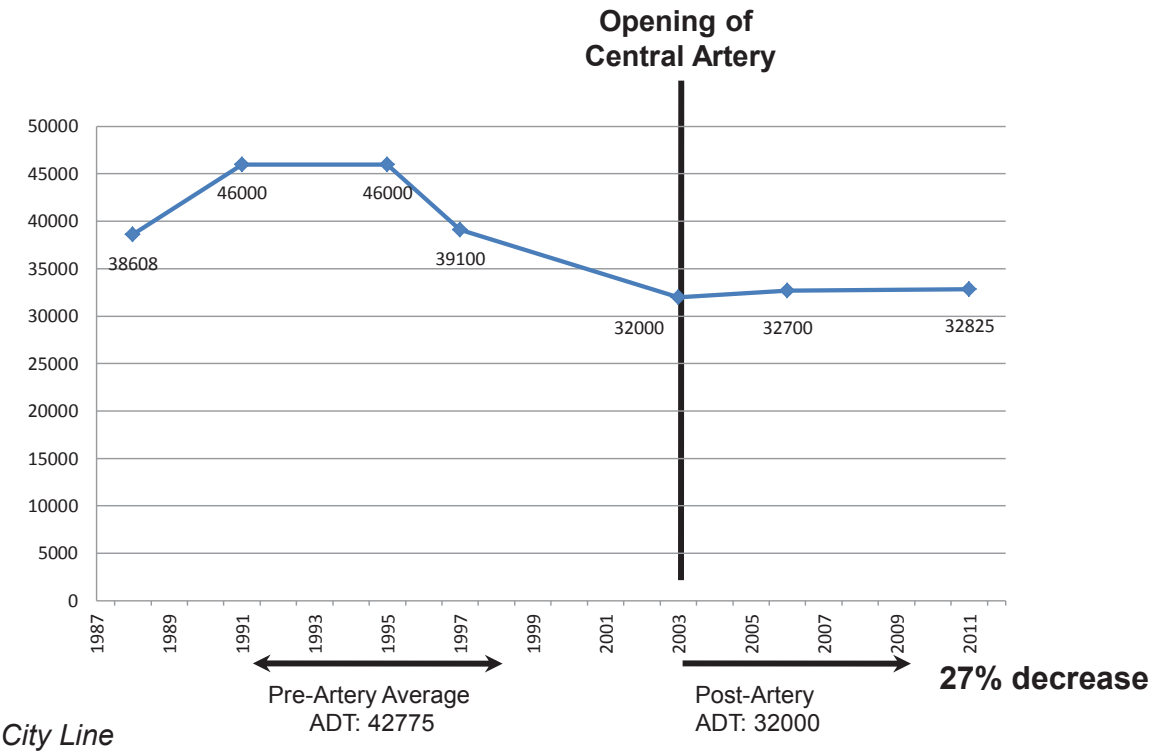
19 October 26, 2010

20 7:00 AM to 9:00 AM and 4:00 PM to 6:00 PM on May 17, 2012

Based on the MTMC data, the morning peak hour was identified as 8:00 AM to 9:00 AM and the afternoon peak hour as 5:00 PM to 6:00 PM. Summaries of the turning movement counts by intersection are provided in Figure 2-33 and Figure 2-34. A complete set of MTMC data and ATR data can be found in Appendix C of this report.

In order to further understand the major movements within the corridor, the TMC data was summarized. The summary diagrams in Figure 2-35 and Figure 2-36 were prepared for the June 2011 Working Group meeting, depicting the sum of roadway volumes for specific roadway segments in the AM and PM peak hours. The volume associated with each arrow is the sum of the turning movement counts at a particular point along the McGrath corridor, and the width of each arrow is proportional to this volume. In this way, these figures provide a sense of the scale of traffic volumes throughout the corridor. The following key points emerged from traffic data analysis and is contained in the summary diagrams:

- There is an imbalanced directional split: Typically, the peak period in the morning mirrors the afternoon reverse movement. However, southbound volumes are 12% higher on the McCarthy Viaduct and 19% higher on Monsignor O'Brien Highway in Cambridge in the AM peak than are the northbound volumes in the PM peak. This indicates that drivers may seek alternative routes in the PM.
- There are more than 900 vehicles that use Medford Street southbound during the morning peak period. This serves as an alternative access route from Route 28 to reach points in East Cambridge.
- Traffic volumes are generally highest between Washington Street and Medford/Highland Avenue.
- There are substantial volumes (more than 1,000 vehicles during peak periods) on the major cross streets: Broadway, Medford/Highland, Washington, Somerville Avenue/Medford Street, Third Street, and Land Boulevard.



*Cambridge City Line

Figure 2-32 : Summary of ADT 1987-2011 at Somerville/Cambridge Line

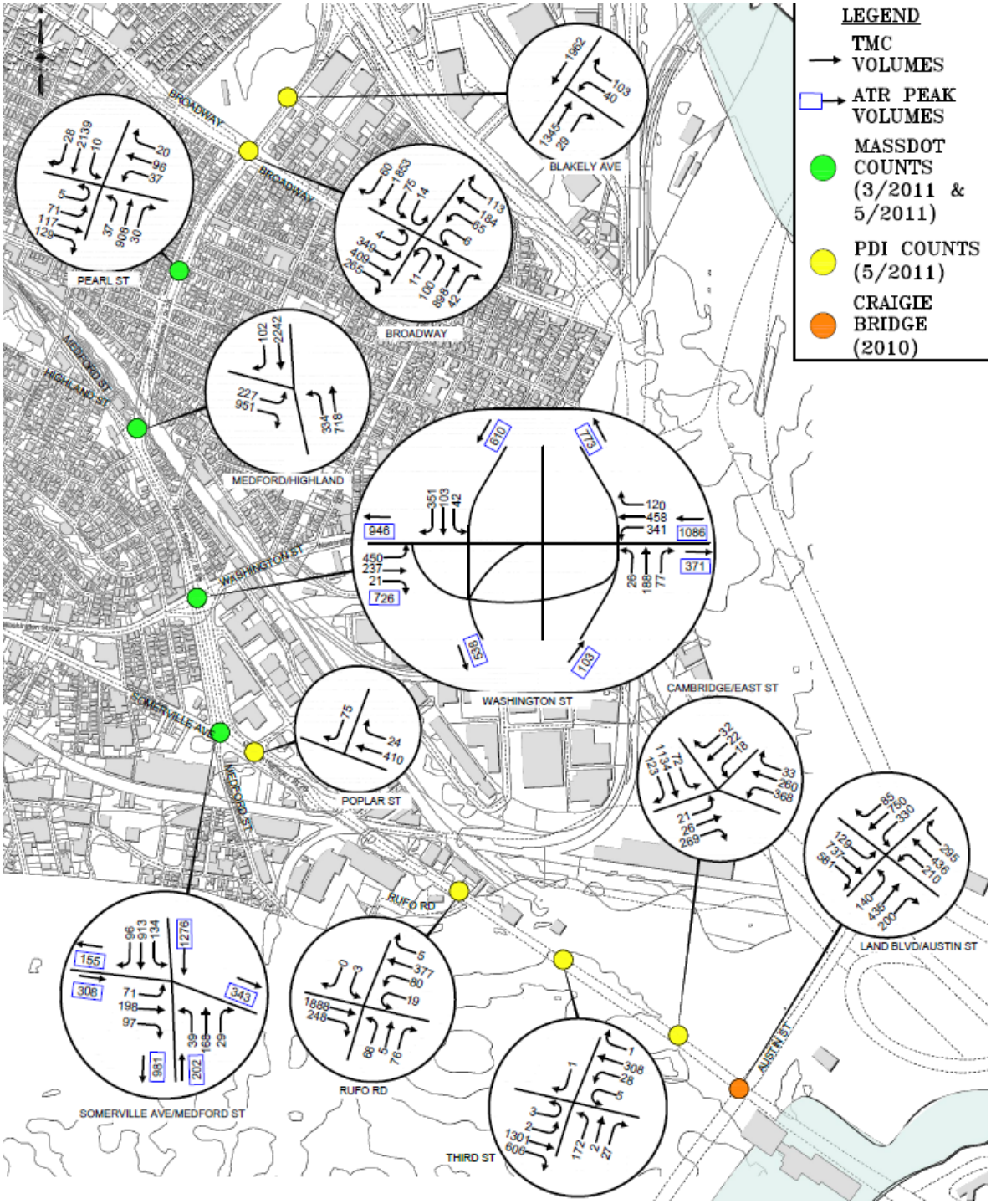


Figure 2-33 : Weekday Morning Peak Hour Traffic Volumes

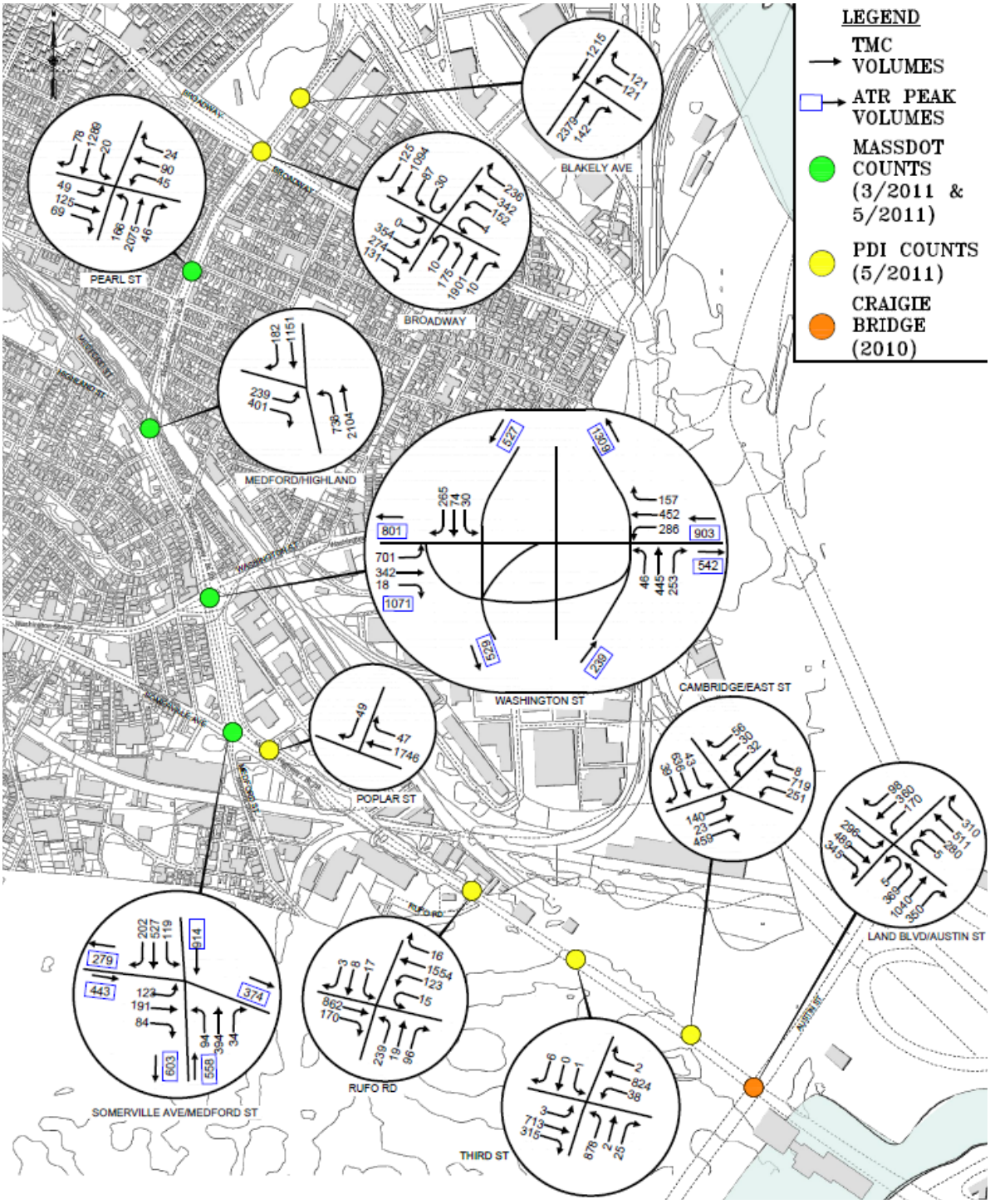


Figure 2-34 : Weekday Afternoon Peak Hour Traffic Volumes

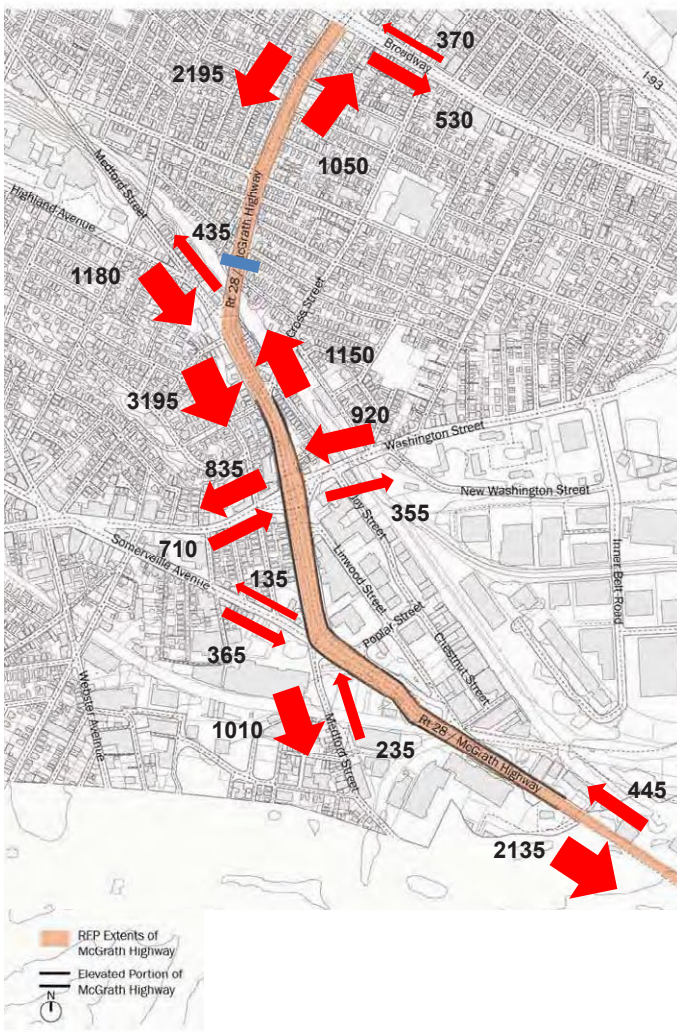


Figure 2-35 : Weekday AM - Summary of Peak Volumes

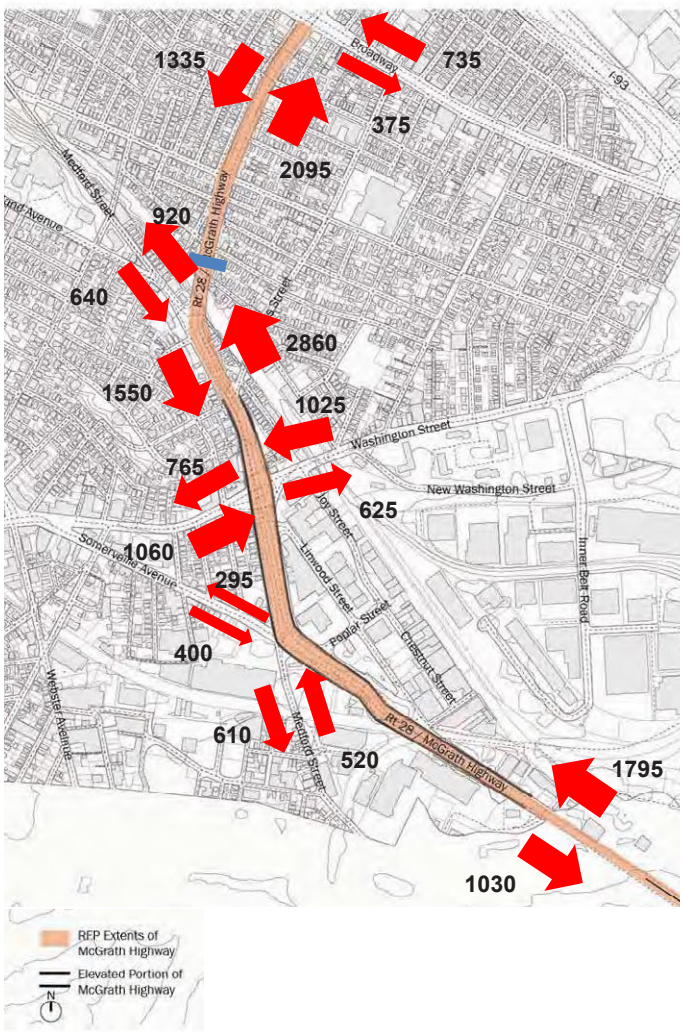


Figure 2-36 : Weekday PM - Summary of Peak Volumes

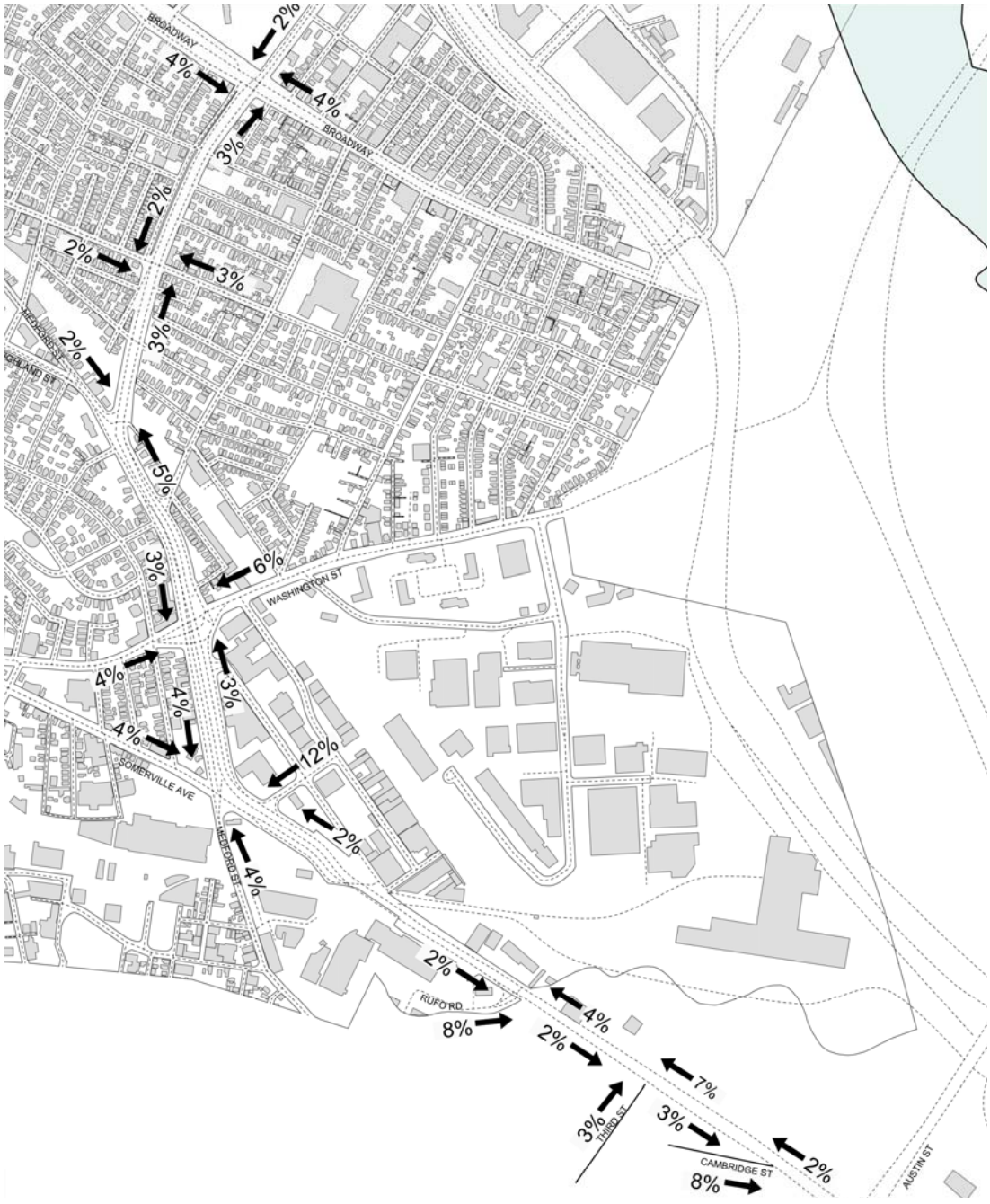


Figure 2-37 : Average Heavy Vehicle Percentages by Intersection

McGrath Corridor Origin - Destination Study

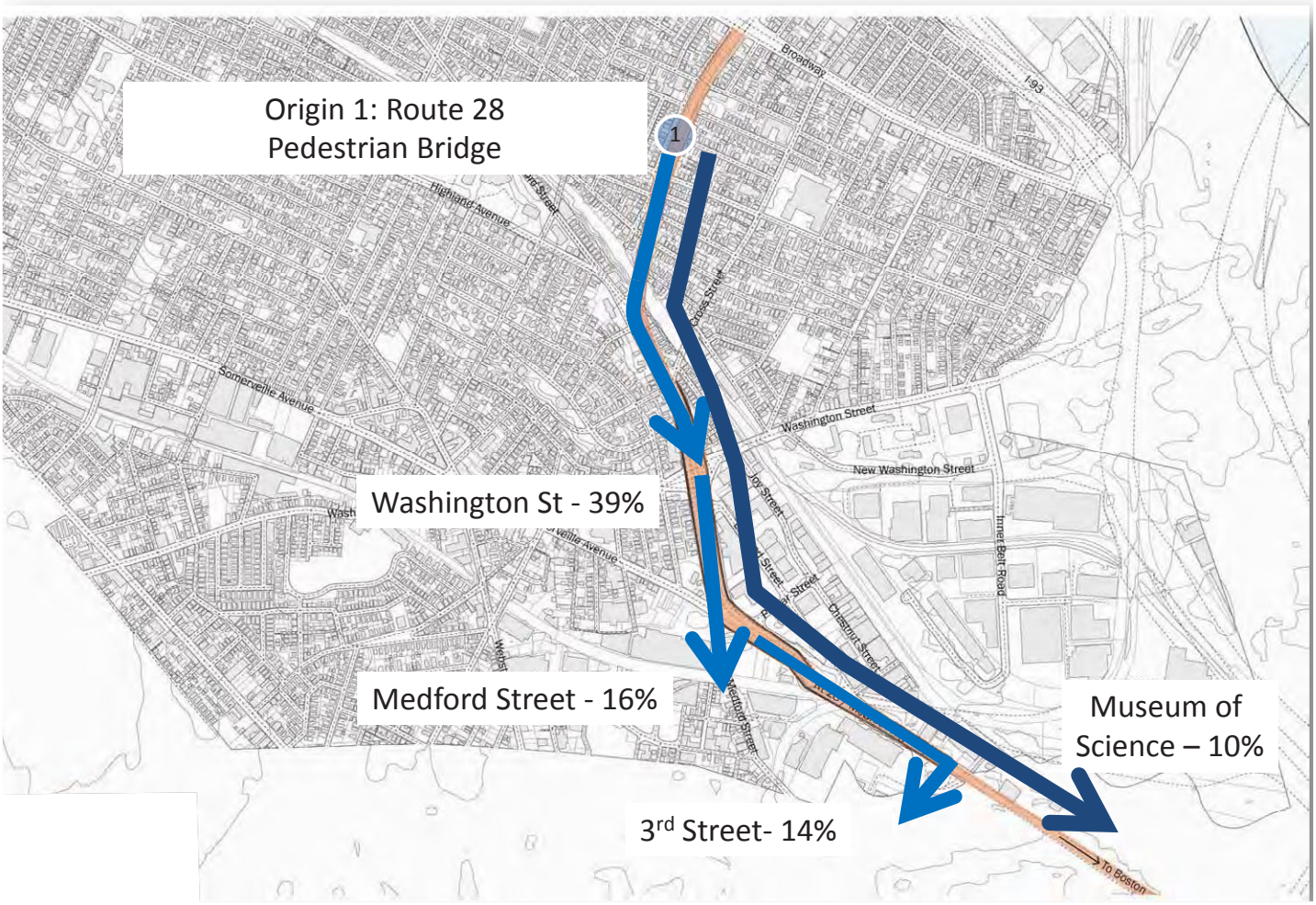


Figure 2-38 : CTPS License Plate Survey – Origin 1

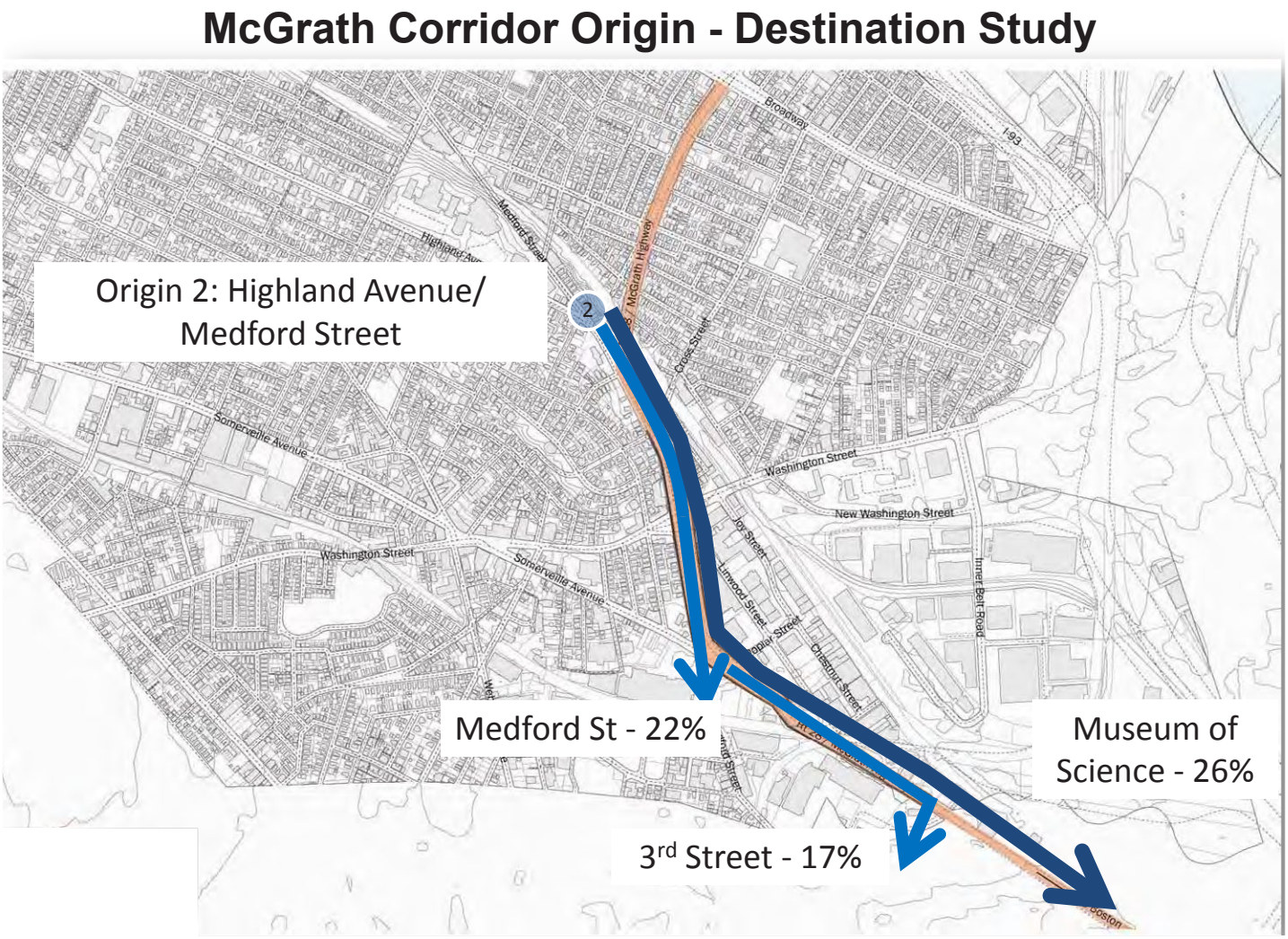


Figure 2-39 : CTPS License Plate Survey - Origin 2

The number of heavy vehicles were included in the weekday morning and weekday afternoon peak period MTMC conducted along the McGrath corridor, and are included in Appendix D. Average heavy vehicle percentages were calculated along the corridor and are depicted in Figure 2-37. A range of 2-4 percent heavy vehicles is typical for an urban area. The higher percentages on the cross-streets is likely reflective of the industrial nature of the abutting land uses that would have greater truck traffic as a percentage of total traffic than residential neighborhoods.

CTPS License Plate Survey

CTPS conducted a vehicular license plate survey in 2011 which focused on the segment of Route 28/ McGrath corridor between the Otis Street pedestrian overpass located between Broadway and Pearl Street in Somerville and the Museum of Science in Boston. The license plate survey was conducted at eleven locations on June 8, 2011, between 7:00 AM and 9:00 AM with follow-up data collection on September 13, 2011. A draft memorandum dated November 8, 2011 was provided to the Grounding McGrath project team, with key findings summarized below.

Based on the data collected, CTPS was able to identify where vehicles using the McGrath corridor are garaged and the typical trips along the corridor by tracking vehicles between three points of origin and eight destinations within the study corridor. See Figure 2-38 and Figure 2-39.

The analysis found that most drivers are using the route for local points of access, with 39 percent of vehicles observed in the McGrath corridor exiting at Washington Street. Only ten percent of the traffic passing the Otis Street pedestrian bridge was observed at the Museum of Science. This use of the McGrath corridor for local points of access will likely be continued as the highest percentage of population and employment growth predicted in the corridor is in the focus area adjacent to future development of the Inner Belt/Brickbottom area, as well as Cambridge destinations such as Kendall Square and NorthPoint.

Pedestrian and Bicycle Activity

Pedestrian and bicycle activity was gathered from a variety of sources, including new counts, as part of the data collection effort for the Grounding McGrath study. While additional counts from background sources both from McGrath corridor intersections and in the surrounding neighborhood have been compiled, the counts included in this section were from new counts collected in the Spring of 2011.

Pedestrian Counts

To show the level of activity and demand for crossings at the most visible locations along the McGrath corridor, both Table 2-3 and Figure 2-40 shows pedestrian crossing volumes for the 2 hour peak period collected in both the morning (7-9 AM) and evening (4-6 PM) peak periods. The highest volumes of AM and PM activity are at Washington Street, showing the importance of this crossing. The comparatively high volumes of pedestrians may be due, in part, to the bus stop on Washington Street, under the McCarthy Viaduct. As the main connection to the future Brickbottom/ Washington Street Green Line station, the need for crossing at this location is likely to grow significantly.

Table 2-3: Pedestrian Crossing Volumes along McGrath Corridor

Intersection	AM Counts	PM Counts
Broadway	33	15
Washington	177	297
Somerville Ave	125	154
Third Street	34	104

Additional pedestrian counts were collected at a number of other corridor locations. The total pedestrian crossings for each peak hour at each intersection are shown in Table 2-4.

Table 2-4: Additional Pedestrians Counts at other Corridor Locations

Intersection Name	AM Ped	PM Ped
O'Brien Highway/W. Cambridge Street	7	8
Lechmere Bus Station	37	43
McGrath /3rd Street	19	22
McGrath /Rufo Road	15	25
McGrath /Poplar Street	4	3
McGrath /Pearl Street	38	18
McGrath /Blakeley Avenue	3	6

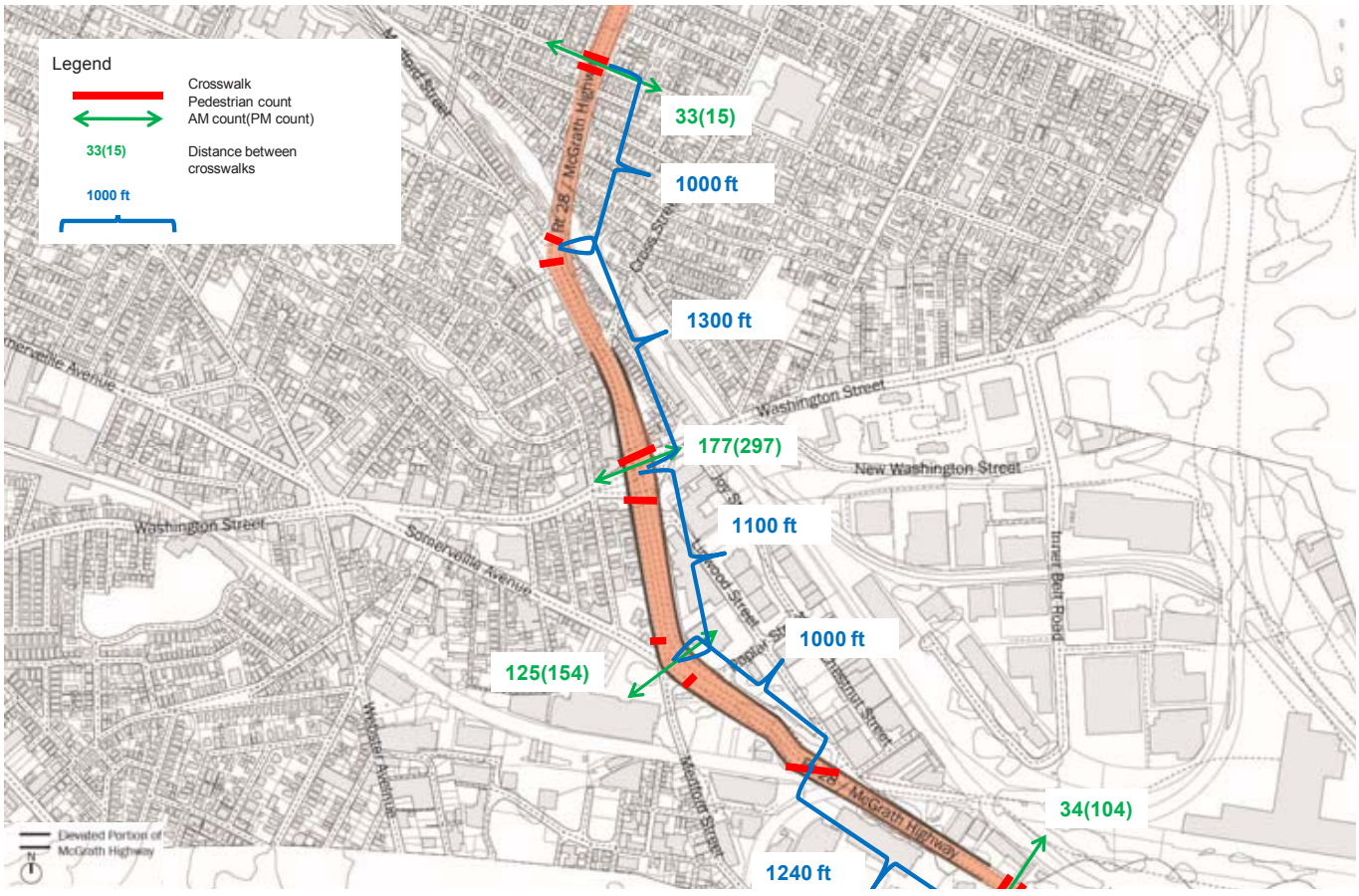


Figure 2-40 : Existing Crosswalk Length Measurements along McGrath

Bicycle Counts

Bicycle counts were taken in conjunction with the pedestrian counts in the corridor, and include both AM and PM peak counts. The observed counts are shown in the Table 2-5 and Figure 2-41. Bicycling activity along the McGrath corridor is relatively low. The observed counts show that bicyclists use the cross streets – Broadway, Washington Street – at higher volumes than along the McGrath corridor.

Table 2-5: Bicycle Counts along McGrath Corridor

Segment	AM Counts	PM Counts
On The McGrath corridor		
Between Broadway and Medford	11	11
At Medford	4	4
McGrath below the McCarthy Viaduct	25	25
Squire's Bridge	8	5
Intersecting Streets		
Broadway	22	27
Pearl	5	9
Washington (west of McGrath)	33	67
Washington (at McGrath)	67	74
Washington (east of McGrath)	57	54
Medford Street	34	22

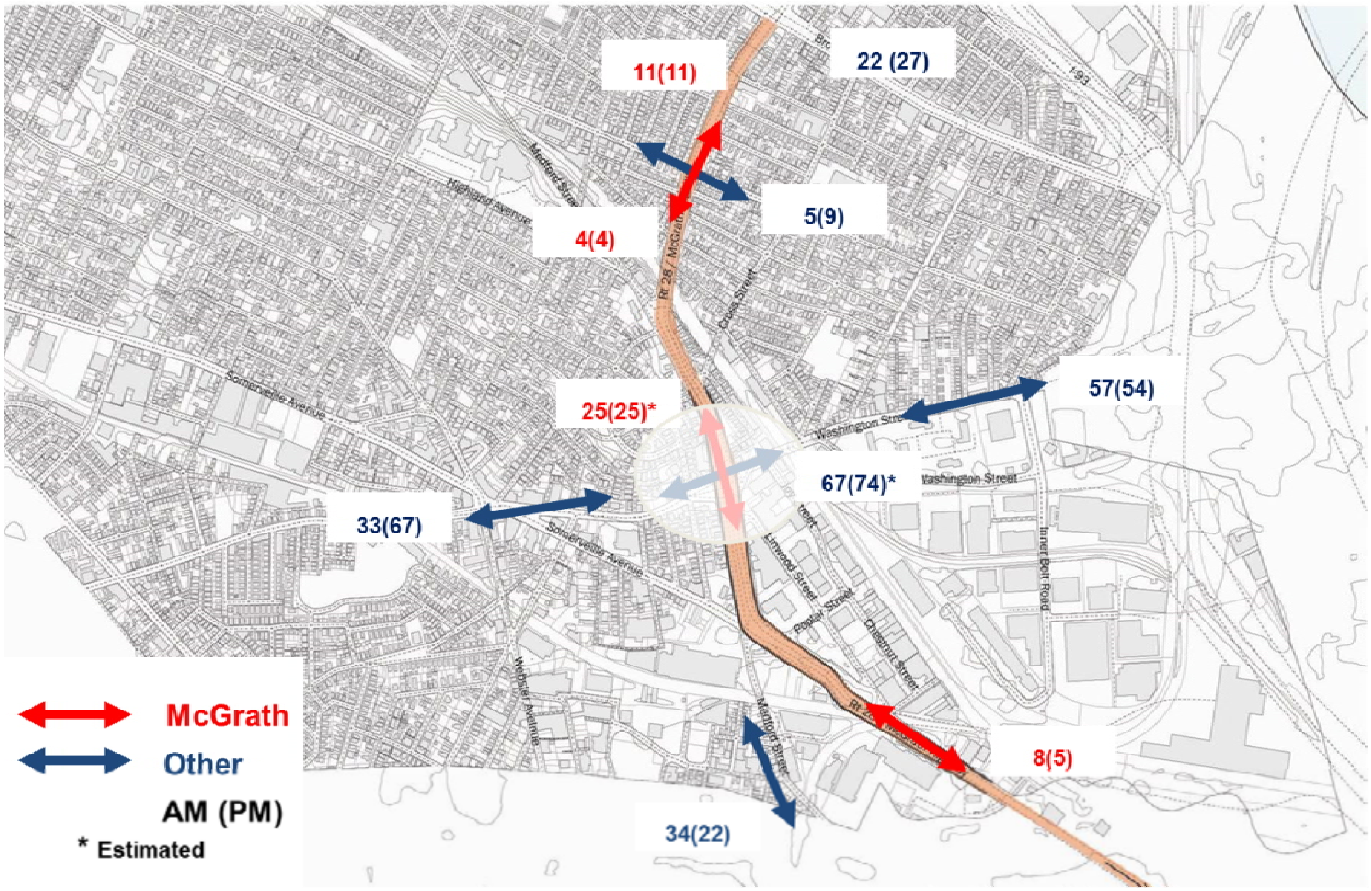


Figure 2-41 : McGrath Bicycle Counts

Vehicular Capacity Analysis

A detailed capacity and level-of-service analysis for the peak hours was performed using Synchro software based on existing traffic flows in the study area. The methodologies employed and analysis results are described in detail below. Detailed Existing Conditions capacity/queue analysis worksheets can be found in Appendix E.

A Synchro network was developed to represent the existing conditions at the eleven study area intersections of the Grounding McGrath study for the weekday morning and weekday afternoon peak hours. A number of sources were combined and utilized to create the existing conditions Synchro model. Below is a list of the original sources of Synchro models or signal plans from various municipalities and other projects:

- City of Cambridge
  - » Land Boulevard/Austin Street
  - » Cambridge Street/East Street
  - » Third Street/Route 28

- MassDOT Record Plans
  - » Rufo Road/Route 28
  - » Medford Street/Highland Street
  - » Pearl Street/Route 28
  - » Broadway/Route 28
  - » Blakely Avenue/Route 28

- MassDOT Record Plans/Union Square Study
  - » Medford Street @ Somerville Avenue
  - » Medford Street @ Washington Street

Each of the primary intersections within the Synchro model was field verified in June 2011 for signal timings and intersection geometries. The original Synchro model compiled from other projects and existing signal timing plans was calibrated to reflect the observed signal timings and roadway geometries.

Based on the methodologies from the 2000 Highway Capacity Manual, detailed capacity/level-of-service analysis was completed using Synchro 7.0 software for the existing peak hour traffic volumes at the study area intersections. Operating levels of service (LOS) are reported on a scale of A to F, with A representing the best conditions (with little or no delay) and F representing the worst operating conditions (long delays). The methodology for calculating LOS for an intersection depends on the treatment of the intersection as traffic signal controlled, or stop/yield controlled.

At unsignalized intersections, a methodology for evaluating and reporting the relative functioning of stop or yield sign-controlled intersections is based on several assumptions, including:

- Major street flows are not affected by the minor (stop-sign controlled) street movements.
- Left turns from the major street to the minor street are influenced only by opposing major street through flow.
- Minor street left turns are impeded by all major street traffic plus opposing minor street traffic.
- Minor street through traffic is impeded by all major street traffic.
- Minor street right turns are impeded only by the major street traffic coming from the left.

The concept of stop-controlled or yield-controlled intersection analysis is based on the estimate of average total delay on minor streets. The methodology of analysis relies on three elements: the size and distribution of gaps in the major traffic stream, the usefulness of these gaps to the minor stream drivers, and the relative priority of the various traffic streams at the intersection. The results of the analysis provide an estimate of average total delay for the various critical movements at the unsignalized intersections. Correlation between average total delay and the respective levels of service are provided for unsignalized intersections in the following Table 2-6:

Table 2-6: Level of Service Criteria for Unsignalized Intersections

Level of Service	Control Delay Per Vehicle (seconds)
A	< 10.0
B	10.1 to 15.0
C	15.1 to 25.0
D	25.1 to 35.0
E	35.1 to 50.0
F	> 50.0

At signalized intersections, an additional element must be considered: time allocation. Therefore, level of service is based primarily on the average control delay per vehicle for various movements within the intersection. Volume-to-capacity relationships also affect level of service. Thus, both volume/capacity and delay must be considered to evaluate the overall operation of a signalized intersection. Correlation between average delay per vehicle and the respective levels of service are provided for signalized intersections in the following Table 2-7:

Table 2-7: Level of Service Criteria for Signalized Intersections

Level of Service	Control Delay Per Vehicle (seconds)
A	< 10.0
B	10.1 to 20.0
C	20.1 to 35.0
D	35.1 to 55.0
E	55.1 to 80.0
F	> 80.0

The overall weekday morning and weekday afternoon peak hour levels-of-service (LOS) for the study area intersections are summarized and depicted in Figure 2-42 and Figure 2-43. Please note that individual movements within each intersection may differ from the overall intersection LOS. For more detail, tables summarizing LOS, volume/capacity (v/c) ratios, queue lengths and delay are included in Appendix E.

Based on the existing conditions capacity analysis, the at-grade study area intersections currently operate with relatively moderate vehicular congestion and delay for an urban roadway, with a few exceptions. Those congested intersections with the McGrath corridor include:

- Broadway: This intersection operates at LOS D during the morning peak period, and degrades to LOS E in the evening peak with long queues and high delays for the northbound and southbound left-turn movements.
- Medford Street/Highland Avenue: During the morning peak period, this intersection has a volume of eastbound traffic

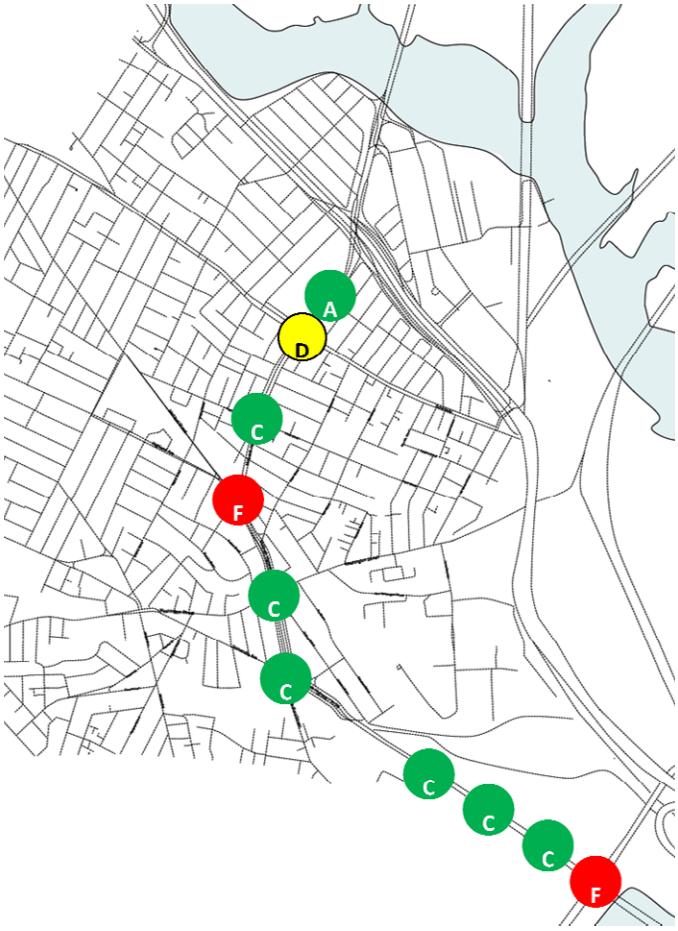


Figure 2-42 : 2011 Weekday AM LOS

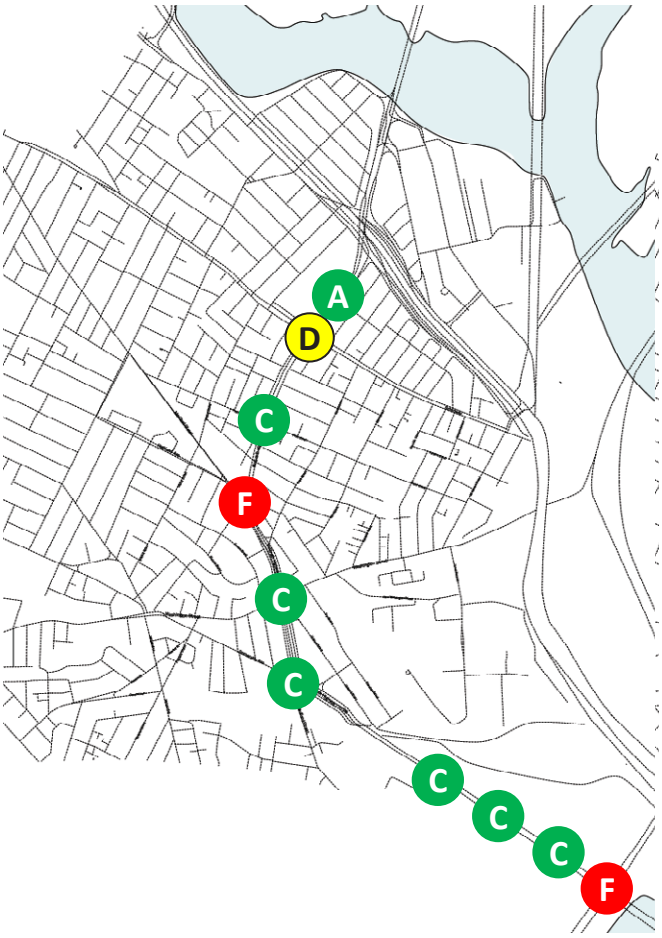


Figure 2-43 : 2011 Weekday PM LOS

Crash Summary

McGrath Highway

(includes McGrath Highland Ave/Medford)

	On Highway (between intersections)	Blakeley Ave	Broadway	Pearl St	Medford St. & Greenville St.	Prospect Hill Ave. & Cross St.	Washington St.	Somerville Ave. & Poplar St.	Medford St & Somerville Ave	Rufo Rd.	Third St	East St & Cambridge St	Land Blvd & Austin St
Year													
2006	7	8	23	12	5	0	17	7	12	0	3	7	7
2007	2	12	14	8	11	0	21	18	19	1	5	5	18
2008	6	16	14	9	9	3	20	10	9	0	6	11	18
Total	15	36	51	29	25	3	58	35	40	1	14	23	43
Type													
Angle	2	17	7	7	6	0	16	11	13	1	5	5	14
Rear-end	4	16	29	11	7	1	12	6	10	0	0	7	18
Sideswipe	2	2	5	6	5	0	12	4	4	0	4	2	6
Head-on	0	0	1	1	0	0	0	0	0	0	1	0	0
Single Vehicle	6	1	7	0	4	2	14	3	4	0	2	7	3
Other	1	0	2	4	3	0	4	11	9	0	2	2	2
Total	15	36	51	29	25	3	58	35	40	1	14	23	43
Type II													
Peds	0	0	3	0	1	0	0	0	0	0	1	2	1
Bikes	0	0	1	0	3	0	2	1	2	0	0	0	0
Other (Wheelchair, etc.)	0	0	0	0	0	0	0	1	1	0	0	0	0
Total	0	0	4	0	4	0	2	1	2	0	1	2	1
Severity													
Property Damage	9	17	27	18	13	2	36	18	20	0	7	12	30
Personal Injury	3	14	16	8	9	0	16	12	13	1	5	7	12
Fatality	0	0	0	0	0	0	0	0	0	0	0	1	0
Unknown	3	5	8	3	3	1	6	5	7	0	2	3	1
Total	15	36	51	29	25	3	58	35	40	1	14	23	43
Weather													
Clear	4	24	36	21	15	0	28	25	29	1	10	16	33
Cloudy	8	4	4	1	7	1	15	4	3	0	1	2	4
Rain	3	5	8	5	2	0	11	4	6	0	2	4	4
Snow	0	0	2	1	1	1	1	0	0	0	1	0	1
Ice	0	0	0	0	0	0	0	0	0	0	0	0	0
Sleet	0	0	0	0	0	0	0	0	0	0	0	0	0
Fog	0	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	3	1	1	0	1	3	2	2	0	0	1	1
Total	15	36	51	29	25	3	58	35	40	1	14	23	43
Time													
7:00 AM to 9:00 AM	1	2	5	5	3	0	8	3	4	0	3	1	5
9:00 AM to 4:00 PM	7	17	24	8	6	0	19	13	18	0	4	7	10
4:00 PM to 6:00 PM	2	2	5	7	4	1	3	5	6	0	2	0	7
6:00 PM to 7:00 AM	5	15	17	9	12	2	28	14	12	1	5	15	21
Total	15	36	51	29	25	3	58	35	40	1	14	23	43
Crash Rate	n/a	0.74	0.85	0.58	1.29	0.13	1.55	1.56	1.86	0.03	0.41	0.78	0.76
District 6 (4) Average		0.78	0.78	0.78	0.59	0.59	0.78	0.59	0.78	0.78	0.78	0.78	0.78
State Average		0.82	0.82	0.82	0.62	0.62	0.82	0.62	0.82	0.82	0.82	0.82	0.82

Source: MassDOT

Prepared by McMahon Associates 6/29/11

Figure 2-44 : MassDOT Crash Rate Worksheet

turning right and a high volume of southbound through volumes that result in vehicle delay and an overall LOS F.
- Land Boulevard: During both the morning and evening peak periods, this intersection experiences long queues and high delay, particularly the northbound and southbound left-turn movements, and the westbound movements.

The elevated sections of Route 28 generally operate with principally free-flow conditions for the mainline of the McGrath corridor, while the surface roads experience some delay. The queues from the Washington Street intersection frequently spill back onto the mainline of the McGrath corridor, which causes some mainline delay. This situation is complicated by driver confusion regarding appropriate use of lanes in the vicinity of Washington Street under the McCarthy Viaduct.

Safety Analysis

Crash Data

In addition to traffic volume data, a traffic safety analysis was performed for all study area intersections on the McGrath corridor using 2006-2008 crash data from MassDOT[21] and crash data provided by the Somerville Police Department (PD). The crash data is a compilation of crash reports submitted to the Registry of Motor Vehicles (RMV) from local, state, and public transportation police departments as well as from citizens, and is summarized in this section. The crash data is summarized by year, type, severity, weather conditions and time of day.

A comparison of the overall number of crashes between the MassDOT and Somerville PD data was conducted to ensure that there were no gaps or discrepancies in the analysis, and is shown in Table 2-9. The differences between the two data sources in terms of the number of total crashes reported are slight (within 2 crashes), with the greatest difference in 2006 (less than 5 percent). Please note that although the Route 28 intersection with Mystic Avenue is not within the Grounding McGrath study area, it was part of the Somerville PD crash data. Therefore, in order to present a consistent comparison, MassDOT crash data for the Mystic Avenue intersection was included in the summary presented in Table 2-8.

Table 2-8: Comparison of Somerville PD and MassDOT Crash Data

Year	Somerville PD Data	MassDOT Data
2006	170	162
2007	167	168
2008	153	155

MassDOT Crash Rate Worksheets

MassDOT Crash Rate Worksheets were used to determine whether the crash frequencies at the study area intersections were unusually high given the volumes at each location. The MassDOT Crash Rate Worksheet is used to calculate the crash rate for an intersection, expressed in crashes per million entering vehicles. The calculated rate is then compared to the average crash rates for signalized and unsignalized intersections within the particular MassDOT District, which are shown in Figure 2-44: MassDOT Crash Rate Worksheet. The city of Somerville is located in MassDOT District 4 and the city of Cambridge is located within MassDOT District 6.

21 The most recent three year period for which data was available when the analysis was completed in early 2011.

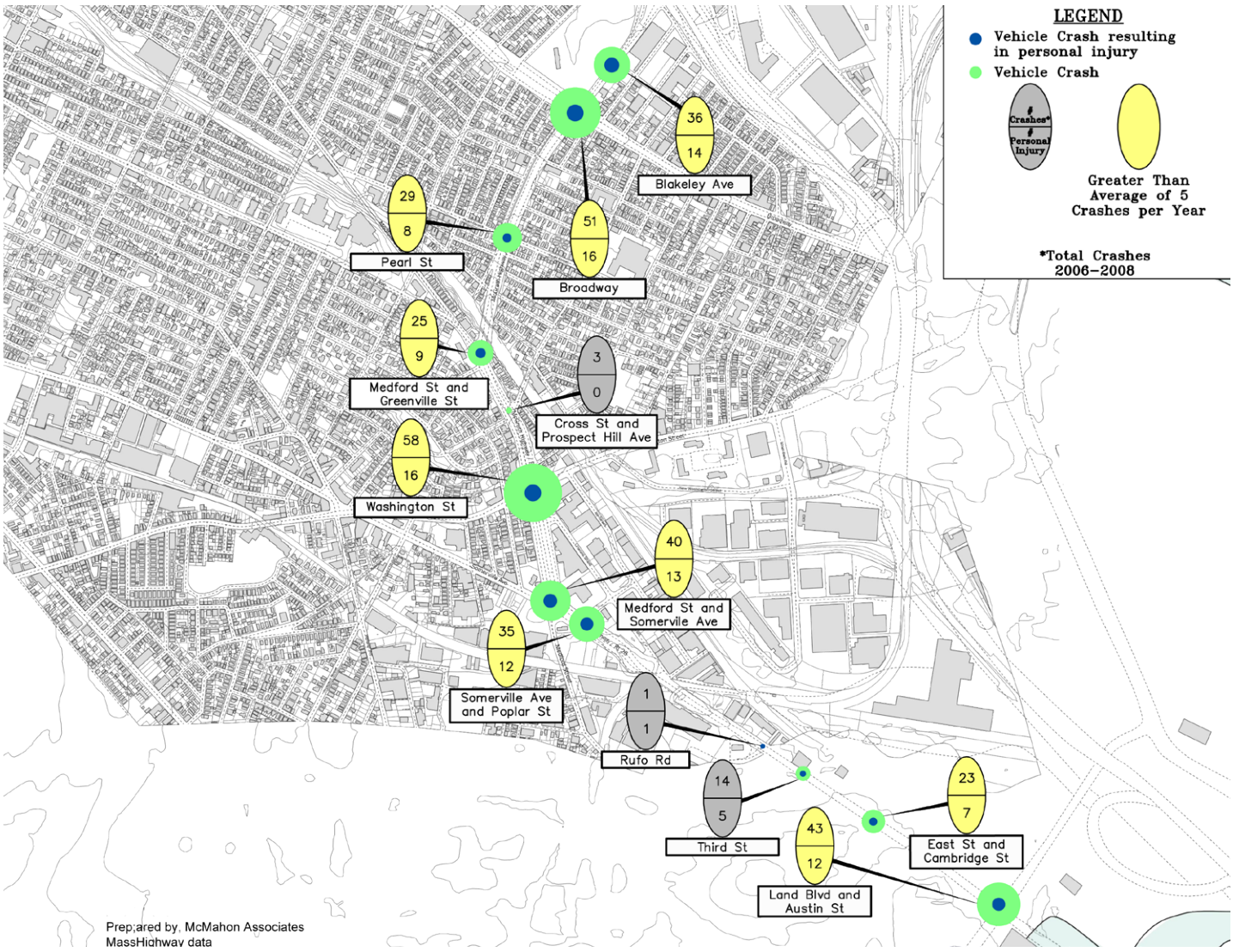


Figure 2-45 : Summary of Total Crashes by Intersection

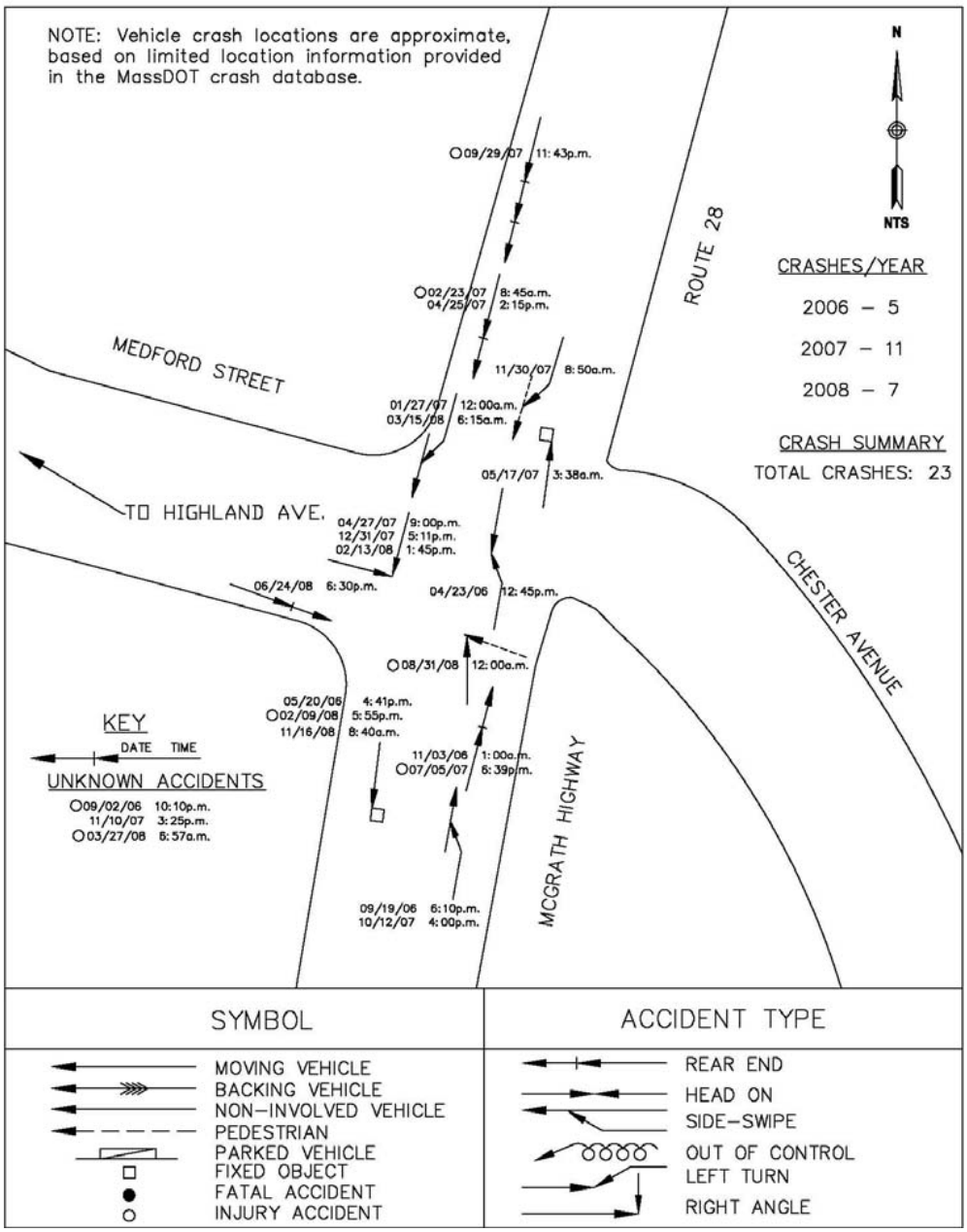


Figure 2-46 : Crash Diagram 2006-2008, Medford Street (Highland Avenue) at The McGrath corridor

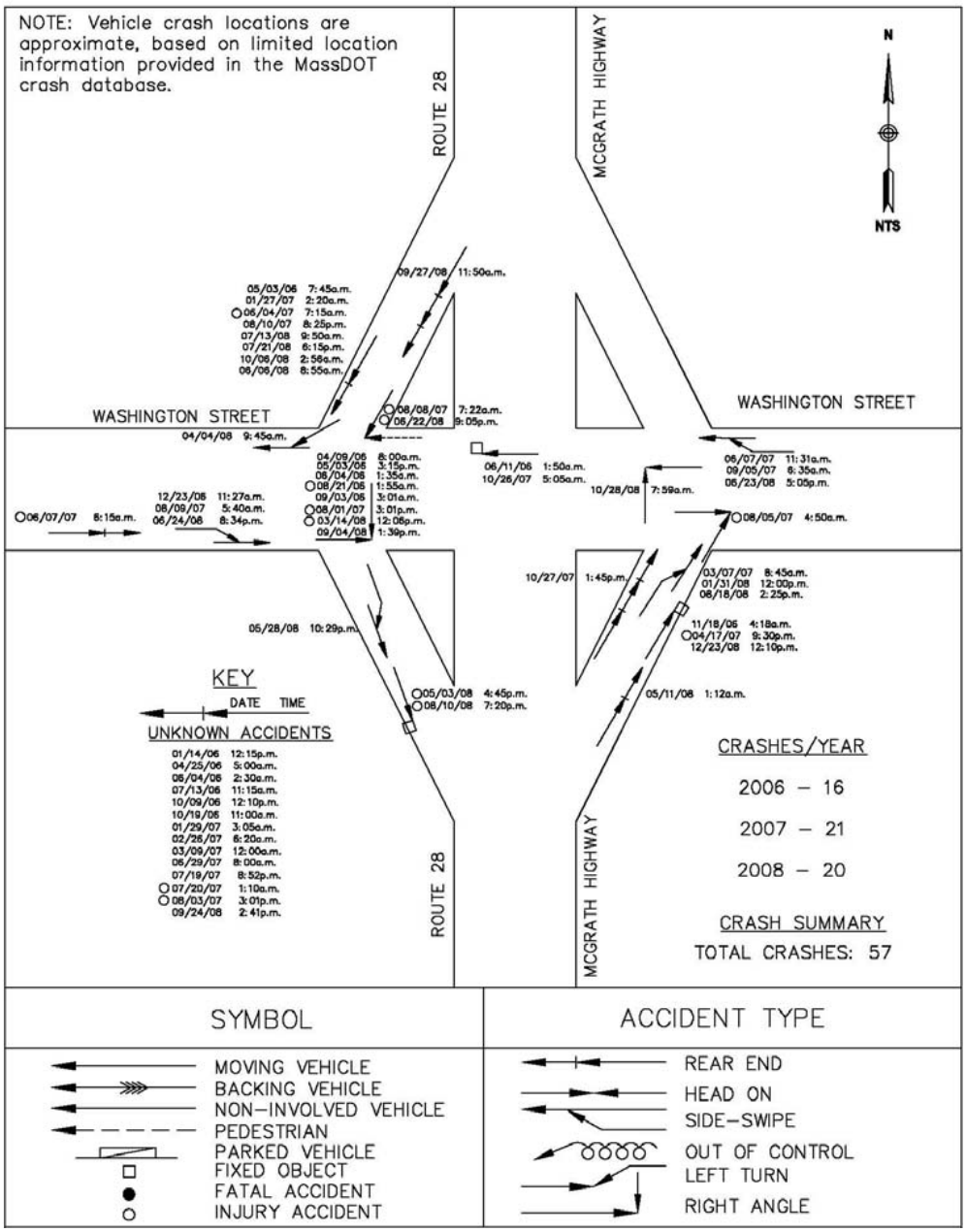


Figure 2-47 : Crash Diagram 2006-2008, Washington Street at The McGrath corridor

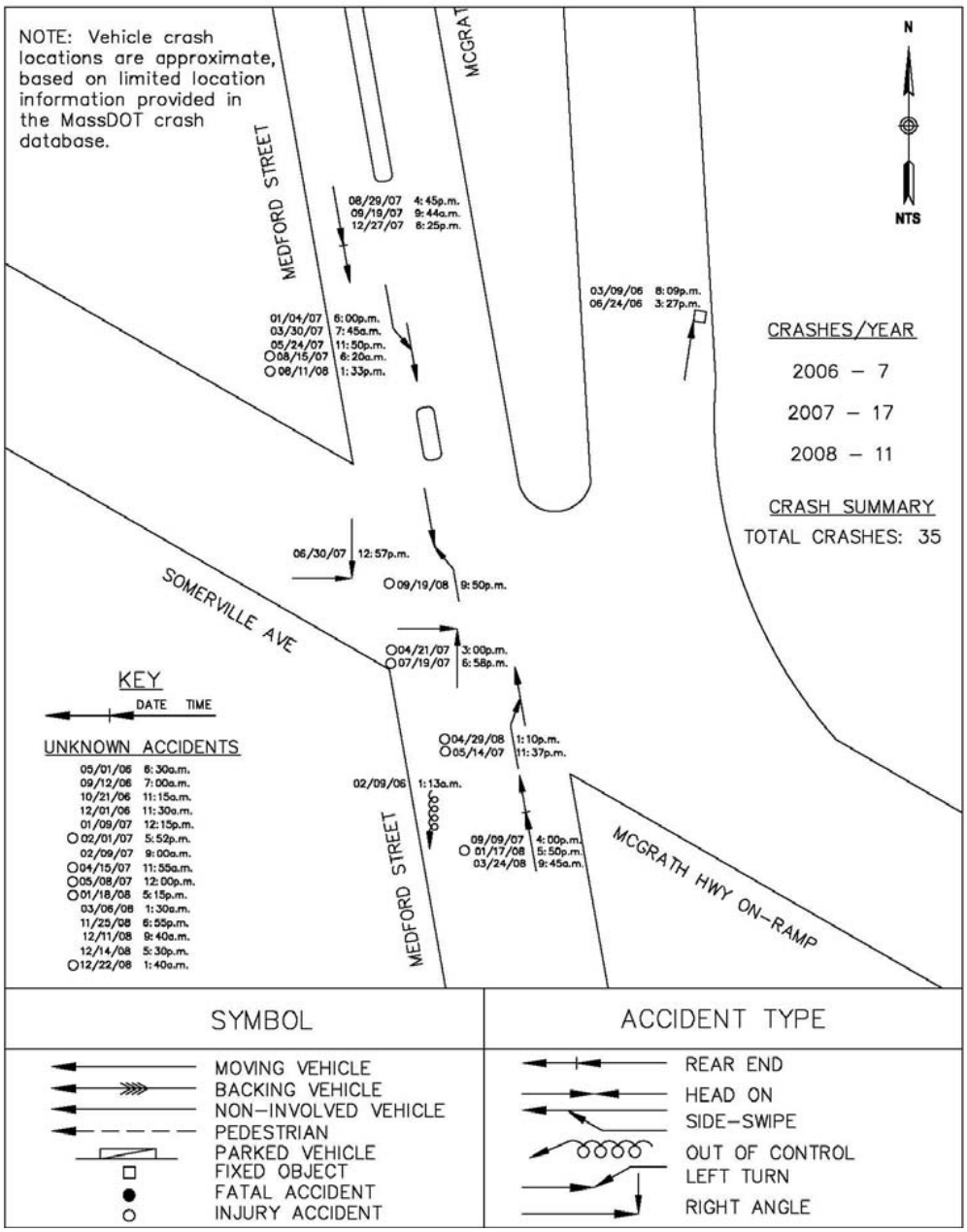


Figure 2-48 : Crash Diagram 2006-2008, Medford Street at Somerville Avenue

In 2010, MassDOT Districts 4 and 6 experienced an average crash rate of 0.78 crashes per million entering vehicles for signalized intersections and 0.59 crashes per million entering vehicles for unsignalized intersections. The statewide averages were 0.82 crashes per million entering vehicles for signalized intersections and 0.62 crashes per million entering vehicles for unsignalized intersections. MassDOT Crash Rate Worksheets are provided in Figure 2-44. Figure 2-45 is a summary of crash data for all study area intersections, and also highlights locations that experienced more than 5 crashes per year between 2006-2008.

Summary of safety analysis findings include:

- McGrath corridor intersections with Broadway, Washington Street, Somerville Avenue/Poplar Street exceed average crash rates.
- Personal injury was reported approximately 33 percent of the time as a result of the crashes at study area intersections. The intersections with greatest number of crashes resulting in personal injury included Route 28 at Washington Street, Poplar Street, and Medford/Highland Avenue/Greenfield Street.
- Approximately 17 percent of the reported crashes from 2006-2008 involved pedestrians or cyclists (based on the Somerville Police Department data).
- The remaining study area intersections experienced crash rates below the state wide and District 6 and District 4 averages, which suggests that there are no significant safety deficiencies at these intersections.

In order to more fully understand and possibly identify the cause of the crashes at the intersections that exceed the average Statewide and District 6 crash rates, it is necessary to determine not only the number of crashes, but also the type of crashes. For example, rear-end crashes can be typical of a signalized intersection or congested location. Angle collisions can be due to unusual or substandard roadway geometry. Angle collisions are often between vehicles traveling in opposite directions, and can be particularly dangerous due to higher effective speeds.

The Somerville Police Department was not able to provide detailed crash reports containing collision diagrams and narrative description of collisions. Therefore, collision diagrams were developed by the Grounding McGrath project team based on approximate locations of crashes contained in the MassDOT crash database. Collision diagrams were developed for intersections that met the following criteria:

- Exceed a crash rate of 1.0 crashes per million entering vehicles[22]
- More than five crashes per year
- High number of angle collision crashes

The following four intersections met these criteria:

- Medford Street (Highland Avenue) Avenue at McGrath (see Figure 2-46)
- Washington Street at McGrath (see Figure 2-47)
- Medford Street (including McGrath southbound ramps) at Somerville Avenue (see Figure 2-48)
- Somerville Avenue at Poplar Street (see Figure 2-48)

Medford Street (Highland Avenue) at McGrath

- Crash Rate= 1.29
- District 4 Average= 0.59
- State Average= 0.62
- Total Crashes from 2006-2008= 25
- Mostly angle and rear-end crashes
  - » Rear-end crashes occurred most often in the right-turn lane, particularly southbound on Route 28
  - » Side-swipe crashes occurred in both the northbound and southbound directions.
  - » A left-turn crash occurred in the northbound direction.
  - » Right angle crashes occurred in both the eastbound and northbound approaches.
  - » Several crashes occurred with a fixed object in the southbound direction, south of the intersection.
  - » The location of four crashes could not be determined based on the information available.

22 Engineering judgment and national standards suggest that rates exceeding 1.0 are worthy of further study. The district rate is an average rate and does not necessarily mean that it is a dangerously high crash rate – only that it is above the average.

McGrath Hwy. Accident Report												
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	total
Accident/ Hit & Run	19	28	10	17	20	13	19	27	26	27	19	225
Accident / MV	120	128	106	88	117	125	124	101	127	108	41	1185
Accident / Pedestrian	2	4	6	4	4	4	4	4	5	0	4	41
Accident / Pedestrian / Injury	33	31	23	25	25	24	19	19	18	19	9	245
Accident / Bicycle	0	0	0	0	0	4	1	2	0	1	0	8
Accident / Property / Damage	0	0	0	0	0	0	0	0	0	1	0	1
Total Incidents	174	191	145	134	166	170	167	153	176	156	73	1705

Figure 2-49 : McGrath Corridor Bicycle and Pedestrian Crash Report

Washington Street at McGrath
- Crash Rate= 1.55
- District 4 Average= 0.78
- State Average= 0.82
- Total Crashes from 2006-2008= 58
- High number of crashes at this location, including 16 angle and 14 single vehicle crashes.
  - » Angle collisions may be due to driver confusion regarding lane assignments with difficult merges. Angle collisions occurred more frequently at the Washington Street eastbound approach and McGrath southbound ramps, than any other intersection approach for which crash details were available.
  - » Rear-end crashes occurred more frequently on the southbound ramp from McGrath than any other approach for which crash details were available. Rear-end crashes also occurred on the northbound approach to Washington Street.
  - » High number of single vehicle crashes could be due to confusing circulation patterns and traffic maneuvering around bridge columns and pedestrians.
  - » There are some side-swipe crashes for all approaches.
  - » The location of 14 crashes could not be determined based on the information available.

Medford Street (including McGrath southbound ramps) at Somerville Avenue
- Crash Rate= 1.86
- District 4 Average= 0.78
- State Average= 0.82
- Total Crashes from 2006-2008= 40
- Large number of angled collisions and rear-ends.
  - » Most crashes happened during the nighttime
  - » The majority of crashes, for which location information was available, involved the northbound and southbound approaches.
  - » Driver confusion may contribute to the crashes due to the intersection geometry with a very large open area in middle of the intersection, as well as unclear pavement markings.
  - » The location of 15 crashes could not be determined based on the information available.

Somerville Avenue at Poplar Street
- Crash Rate= 1.56
- District 4 Average= 0.59
- State Average= 0.62
- Total Crashes from 2006-2008= 35
- 11 angled crashes and 11 unknown crashes.
  - » Vehicles have to merge onto The McGrath corridor without any “taper zone”, which can cause an angle-type crash
  - » Lack of a stop bar or “yield lines” may have contributed to these crashes

Several of these intersections are considered for substantial changes from elevated to at-grade in the long-term alternatives. However, it may be possible to modify intersection geometry in the short-term to improve safety. Intersections are further evaluated in Chapter 5 – Alternatives Analysis as part of the safety analysis. Crash expectancies according to nationally published factors will also be determined for proposed intersection treatments associated with recommendations for the future.

Pedestrian and Bicycle Crash Analysis

The crash analysis described previously was also analyzed further to determine the level of pedestrian and bicycle incidents in the corridor. According to the Somerville Police Department records, approximately 17 percent of the reported crashes from 2006-2008 involved pedestrians and cyclists (see Figure 2-49).

While 17 percent is not necessarily a high rate of incidents, it is higher than the proportion of vehicles to pedestrians generally in the corridor given the high vehicle counts, and relatively low level of pedestrian and bicycle activity. Intersection specific crash data is available for years 2006-2008, but the Somerville Police Department provided a summary of the types of crashes on the McGrath corridor from 2001-2011. This data show pedestrian safety is a significant concern; nearly 86 percent of the 286 pedestrian incidents recorded by the Somerville Police Department between 2001-2011 resulting in injury. There were very few bicycle accidents during this period, but there is also very little bicycle activity in the corridor. It should also be noted that many

of these incidents are reported solely as being on the McGrath corridor, and there is limited ability to trace them to a specific location along the corridor. There also may have been crashes that were not reported, and therefore are not considered in this information.

Several of the intersections with the McGrath corridor are considered for substantial changes from elevated to at-grade in the long-term alternatives. However, it may be possible to modify intersection geometry in the short-term to improve safety. Intersections are further evaluated in Chapter 5- Alternatives Analysis as part of the safety analysis.

Issues and Opportunities

The Existing Conditions analysis has identified many critical issues and opportunities that will drive the development of alternatives and form the quantitative basis for measuring them against the goals and objectives. The issues and opportunities are listed below by category.

Structures

- Two structures on the McGrath corridor are currently slated for or are undergoing repair and/or rehabilitation.
  - » The Gilman Street Bridge is being replaced under MassDOT's Accelerated Bridge Program (ABP). This replacement is currently under design.
  - » The McCarthy Viaduct is currently undergoing a limited but substantive program of short-term repairs and rehabilitation.
- The three structures not slated for repair (the Squire's Bridge, the Lowell Line Bridge, and the Otis Street pedestrian bridge) have condition ratings of Fair or Satisfactory. These three structures typically exhibit isolated areas with deterioration, but do not currently require any repairs in the short term.
- Due to clearance requirements by the MBTA, there are two ""fixed points" in the study area: (1) the truss bridge over the Lowell Line and (2) the Squire's Bridge over the MBTA Fitchburg Commuter Rail Line. Grade separation of roadway and railroad must be maintained in order to avoid creation of a new railroad grade crossing, and the clearance provided at these locations cannot be reduced.
- Roadway design standards for maximum roadway gradient limit the distance required to bring the McGrath corridor to grade from these two fixed points. This distance will be dependent on the design speed for the road, and whether pedestrian routes along McGrath will follow the traffic alignment.
- Changes to the McGrath corridor provide opportunity to improve the cost-effectiveness of infrastructure. Maintenance costs are a significant factor for the corridor. The McGrath corridor is carried by approximately 1,500 feet of bridge structures and 258 feet of tunnel. Maintaining these structures is a large cost.
  - » This is exacerbated by the age of these bridges. They are decades old and have construction details which increase corrosion rates. Deck joints, which expose steel beams to water and de-icing salts, are one example.
  - » New structures would be required to carry McGrath from the fixed points to grade. New construction technologies available today would reduce future maintenance costs required for these structures relative to the requirements for the existing structures.

Pedestrians and Bicyclists

- Pedestrian and bicyclist access, accommodation, and safety must be paramount in any alternatives.
- The Somerville Community Path is planned through this area as part of the GLX, but it should also be incorporated in all alternatives for this study.
- Pedestrian and bicycle connections across and along the McGrath corridor should be developed to ensure the success of this project and the adjacent projects in the study area. Creating new pedestrian access points and sight lines is critical to development of the adjacent neighborhoods.
- There are few legal pedestrian crossings (crosswalks) across the McGrath corridor, with an average of over ¼ mile between crossings. Even where pedestrian crossings exist, they are difficult,

confusing, long, and uninviting. Elevated and at-grade, the McGrath corridor is a pedestrian barrier. Sidewalks and pedestrian connections along the corridor are inconsistent.
- A surprisingly high volume of pedestrians cross the McGrath corridor at crosswalks, showing very strong pedestrian desire lines, and may be due to the location of the bus stop on Washington Street under the McCarthy Viaduct.
- Pedestrian connections to the planned Green Line stations are important to consider as part of all alternatives.
- Bicycling is allowed on the McGrath corridor, including on the elevated portions, but this is unclear to bicyclists, and volumes are comparatively low.

Transit

- The MBTA's Green Line serves the eastern part of the study area, with Lechmere as the current end of the line. Lechmere Station also functions as a bus hub for routes 69, 80, 87 and 88. The planned GLX through Somerville provides an opportunity for decreased traffic demands and enhanced economic development.
- Two MBTA commuter rail lines (Fitchburg and Lowell) from North Station pass through the corridor, but do not have station stops in Somerville. While the lines do not service Somerville, the elevated roadway structures over the rail lines are necessary.
- Eleven MBTA bus routes operate in, across, or around the McGrath corridor, including routes CT2, 69, 80, 86, 87,88, 89, 90, 91, 95, and 101. These are primarily east-west routes, providing an opportunity to improve coordination of fixed route service and headways with the planning for the McGrath corridor.
- There are no bus routes that provide a consistent and complete connection along the entirety of the study area from Broadway to Lechmere.
- For the most part, buses do not use the elevated portion of the McGrath corridor, and none use the McCarthy Viaduct. Buses use the surface streets to the extent possible, and must use the Squire's Bridge and the bridge over the Lowell Line. While Union Square and the adjacent corridor neighborhoods all have direct service; the Inner Belt and Brickbottom areas are served along the periphery of either Washington Street or the McGrath corridor.
- Bus stops on the routes that bisect the corridor (Broadway, Washington Street) tend to be close to the McGrath corridor and have challenging pedestrian crossings.
- The total daily ridership boarding and alighting at stops on, or immediately under, or adjacent to, the McGrath corridor, that could potentially be affected by the project is approximately 1,315 passenger trips (Routes CT2, 80, 86, 87, 88, and 91)

Demographics and Land Use

- Removal of elevated portions of the McGrath corridor has the potential to significantly enhance the businesses and residential prospective in neighborhoods and areas that are directly adjacent to the highway. Furthermore, removal could have a positive effect on adjacent businesses and properties. These areas have an opportunity to create a new identity, such as a Main Street or a mixed use boulevard and enhance the economic vitality previously hindered by the shadow and lack of visibility created by McGrath's elevated structure.
- The land use surrounding the McGrath corridor will directly impact and guide the future redevelopment of these areas and impacts would come in stages based on the land use. Overall, owners of existing residential and business properties would gain enhanced access and visibility through removal. Residential development property values would likely increase as neighborhoods become more attractive to developers and visitors.
- Excess right-of-way can be converted and developed into facilities and amenities to support Somerville's neighborhoods such as parks and open space.
- The study area population of 56,560 is growing compared to the rest of Somerville. The population is undergoing an increase in ethnic diversity, as well as an overall decrease in average age, with the percentage of children and elderly shrinking.
- The demographic conditions for significant redevelopment and some new construction exist in the market today, including younger households with higher education levels than before and increasing relative incomes.
- Housing and commercial prices vary widely but

have high points which represent levels at which redevelopment of existing properties and in some places, new construction can be supported.
- The area has seen more development interest based on the GLX project; Decisions about neighborhood character are important and will be based on plans for the McGrath corridor (i.e. is this a main-street style district or part of a larger-scale mixed-use district?).

Environmental

- There are approximately fifteen small parks, playgrounds, and recreation areas along the McGrath corridor or in the immediate study area. Connections to these areas should be enhanced through the McGrath alternatives.
- During significant storm events flooding from the Millers River and sewer overflow can be evidenced in lower portions of the study area, especially near the Somerville Avenue and Poplar Street intersections with the McGrath corridor.
- The roadway itself primarily runs through the soil type "Urban land, wet substratum." However there are segments of the highway and adjacent to the highway of other soil types.
- There are no DEP wetlands in the study area.
- Historically significant areas and neighborhoods, including the Prospect Hill area in Somerville and the Union Railway Car Barn in Cambridge, as well as three National Register Districts: East Cambridge, Winter Street, and Charles River Basin, should be considered in planning the future of the McGrath corridor.
- There are a few DEP oil or hazardous materials sites with Activity and Use Limitation (AUL) along the corridor or immediately adjacent to the McGrath corridor:
  - » Opposite Foss Park
  - » Across the highway from Rufo Road
  - » To the east of Water Street
- In addition, there are several sites in the immediate study area in the Brickbottom and Inner Belt areas, south of the Fitchburg Commuter Rail Line and opposite Foss Park.
- Abutting neighborhoods surrounding the McGrath corridor are at higher risk for respiratory diseases and other health risks due to the heavy traffic volumes and congested intersections along the corridor.
- The presence of the elevated structure likely both shields and exacerbates noise pollution from traffic on the directly adjacent neighborhood.

Vehicular Traffic

- There is an imbalanced directional split: Southbound volumes are 12 percent higher on the McCarthy Viaduct and 19 percent higher on Monsignor O'Brien Highway in Cambridge in the AM peak than are the northbound volumes in the PM peak. This indicates that drivers may seek alternative routes in the PM.
- There are more than 900 vehicles that use Medford Street southbound (at Somerville Avenue) during the morning peak period. This serves as an alternative access point from the McGrath corridor to reach points in East Cambridge.
- Traffic volumes are generally highest between Washington Street and Medford/Highland Avenue.
- There are substantial volumes (more than 1,000 vehicles during peak periods) on major cross streets with the McGrath corridor: Broadway, Medford/Highland, Washington, Somerville Avenue/ Medford Street, Third Street, and Land Boulevard. With the exception of Washington Street, these intersections are already at-grade and experience long queues and high delay during peak periods. The intersections with the McGrath corridor include:
  - » Broadway: This intersection operates at LOS D during the morning peak period, and degrades to LOS E in the evening peak with long queues and high delays for the northbound and southbound left-turn movements.
  - » Medford/Highland: During the morning peak period, this intersection has a high volume of eastbound traffic turning right and a high volume of southbound through volumes that result in vehicle delay and an overall LOS F.
  - » Land Boulevard: During both the morning and evening peak periods, this intersection experiences long queues and high delay, particularly the northbound and southbound left-turn movements, and the westbound movements.

- The elevated sections of the McGrath corridor's east-west cross-streets result in relatively free-flow conditions for the mainline of the McGrath corridor, while the surface roads experience some delay. The queues from the Washington Street intersection spill back onto the mainline of the McGrath corridor causing some delay. This situation is complicated by driver confusion regarding appropriate use of lanes in the vicinity of Washington Street under the McCarthy Viaduct.

- Based on the CTPS License Plate Survey, only 10 percent of vehicles observed in the AM period use the McGrath corridor segment from the Otis Street pedestrian bridge to the Museum of Science. About 39 percent of vehicles observed exited at Washington Street, indicating the McGrath corridor is used for access to and from destinations in Somerville and Cambridge, more than a through route to Boston. This trend will likely be continued as the highest percentage of population and employment growth predicted in the corridor is in the focus area adjacent to future development of the Inner Belt/Brickbottom area, as well as Cambridge destinations such as Kendall Square and NorthPoint.
- Through the Grounding McGrath process a number of immediate concerns about traffic, intersection design and pedestrian safety were raised. These are described further in the Recommendations chapter, but many were evaluated and implemented by the MassDOT District 4 Office in conjunction with this effort.
- Approximately 17 percent of the reported crashes from 2006-2008 involved pedestrians or cyclists (according to the Somerville Police Department).

CHAPTER 3: FUTURE YEAR PROJECTIONS

Introduction

This chapter will analyze how the expected changes in population and other demographic characteristics between 2011 and 2035 will impact transportation in the McGrath corridor. The 2035 future condition without any improvements or changes associated with this study – or Future No-Build condition – assumes that the McGrath corridor functions much as it does today. The purpose of this analysis is to evaluate transportation issues that would be expected to arise in the McGrath corridor and to establish a baseline against which to compare proposed alternatives. Such a comparison is necessary to determine if those options will be functional and appropriate for projected growth within the project area in the future. The Future No-Build condition assumes that no alternatives (including any potential change to the elevated structures or lane configurations) are to be implemented along the McGrath corridor, but accounts for the expected changes in population and employment and the implementation of other transportation projects in the region.

Conditions in the study area are forecasted to the horizon year of 2035, consistent with the Boston Region Metropolitan Planning Organization (MPO)'s Regional Transportation Plan (RTP) and the regional travel demand model managed by the Central Transportation Planning Staff (CTPS), the organization that serves as technical staff for the Boston Region. The CTPS regional travel demand model is used to understand travel demand peak period forecasts under the existing conditions and under a future "no-build" condition in the horizon year of 2035.

The regional travel demand model is continually calibrated to transit counts, traffic volumes, and congested speeds on roadways. Using the Metropolitan Area Planning Council (MAPC) regional land use forecasts as an input into the model, CTPS estimates population, employment, alternative transportation, and vehicle volume growth for 2035. Projects such as the Green Line Extension (GLX), Assembly Square Orange Line Station, and Sullivan Square/Rutherford Avenue improvements are assumed to be completed by 2035, and are therefore included in the regional travel demand model for the horizon year of 2035. It also includes the population, households, and employment projections for the study area. The model is multimodal and represents regional transportation patterns in 164 communities in eastern Massachusetts, including the 101 cities and towns in the Boston Region MPO, as well as 63 additional communities forming a buffer around the region in order to provide model results that are as robust and accurate as possible. Please see Figure 3 - 1 for the municipalities included in the Boston Region MPO.

Analysis

The No Build future year conditions for Grounding McGrath is developed using the adopted 2035 land use and transportation network from the Boston Region MPO's Long-Range Regional Transportation Plan. The socio-economic data in the regional travel demand model is typically developed into population and employment projections for specific transportation analysis zones (TAZ) for current and future analysis years.

- The number of person trips in each TAZ is calculated based upon the population and employment data.
- Mode shares are then applied to the person trips to estimate the vehicular and non-vehicular trips in the region.
- The vehicular trips are then assigned to the regional street network, weighing the trips productions and attractions of each zone and utilizing roadway capacity constraints.

As noted in Figure 3-2, population and employment growth in the Inner Belt/Brickbottom area of Somerville is expected to more than double from 2009 to 2035. This growth is expected to have a significant impact on the trips projected to and from that area in the form of new transit, automobile, and non-motorized (bicycle and pedestrian) trips.

CTPS provided a summary of mode share for the 2011 base year and 2035 No Build. Five neighborhoods were reviewed - Inner Belt/Brick Bottom, East Cambridge, East Somerville, Spring Hill, and Winter Hill. In the base year, the overall transit shares in these five neighborhoods varied from 7.7 percent to 28.2 percent in the AM peak period, and from 9.9 percent to 25.7 percent in the PM peak period. In 2035 with the impact of GLX project, the transit share became 11.8 percent - 32.3 percent in the AM, and 13.0 percent - 26.9 percent in the PM. Between

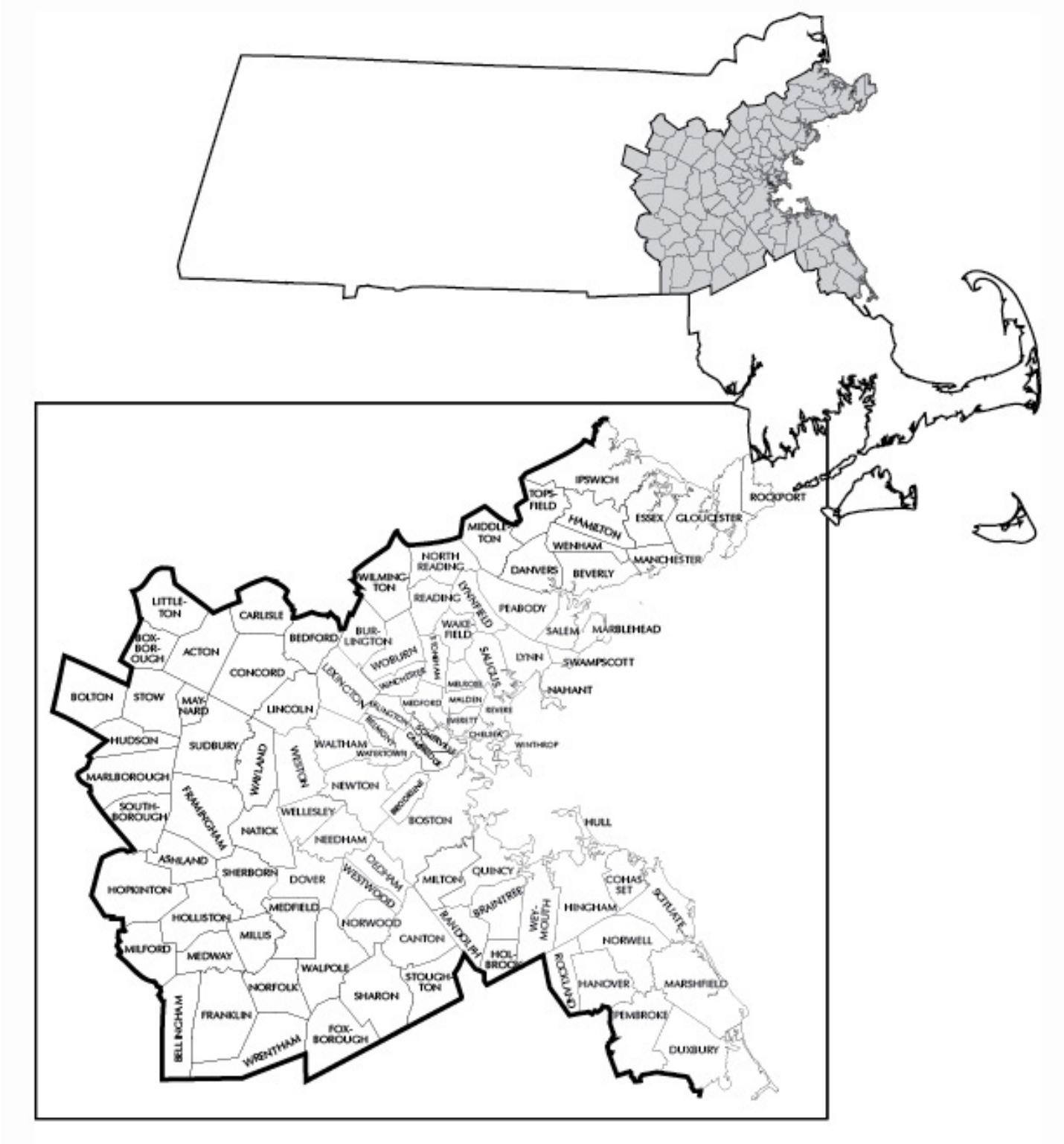


Figure 3-1 : Boston Regional Metropolitan Planning Organization Municipalities

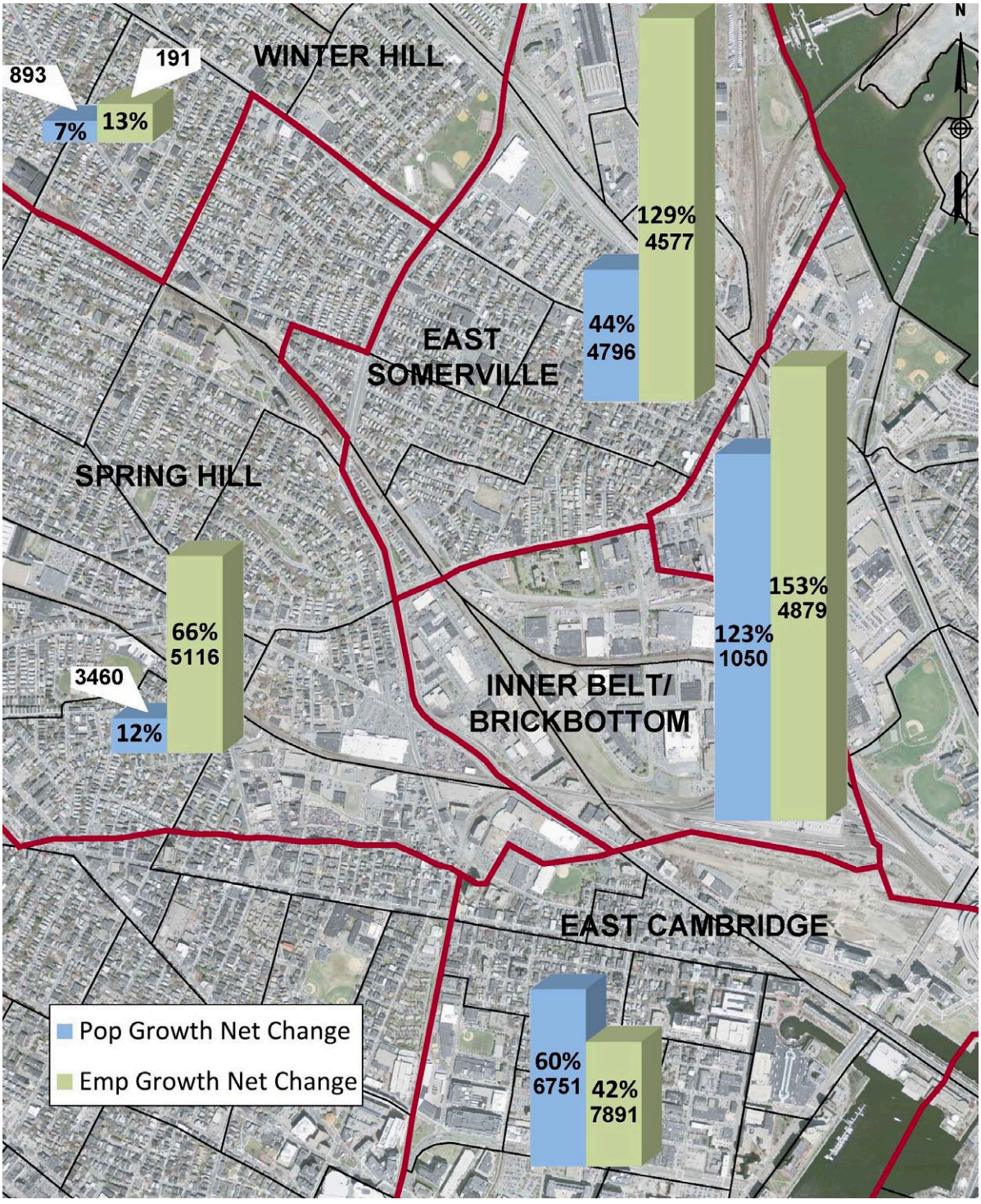


Figure 3-2 : CTPS Population and Employment Growth for 2035 by Neighborhood

2011 and 2035, the estimated trasit share increased, by an average of approximately 5 percent in the AM peak period, and by about 3 percent in the PM peak period.

CTPS supplied the project team with the estimates from the regional travel demand model for growth in traffic volumes, along roadways and at intersections, between the 2011 base year and the 2035 future year. The project team then incorporated the data into a micro-simulation capacity analysis model, using Synchro analysis software, to evaluate traffic operations within the project study area. Growth rates were calculated and applied to the 2011 existing peak hour traffic volumes using methods for three subareas of the study area:

- From Blakeley Street in the north to Highland Avenue/Medford Street. This segment of the McGrath corridor is currently at grade. The CTPS generated outputs for both the McGrath corridor links and intersecting roadway links (Blakely Street, Broadway, Pearl Street, Medford Street) were averaged together for the weekday morning and weekday afternoon peak hours. The average growth rate was calculated and rounded to the nearest half percent, resulting in 7.5 percent growth, which was then applied to the 2011 existing weekday morning and weekday afternoon peak hour traffic volumes.
- Highland Avenue/Medford Street to Poplar Street. For the McGrath Highway segments and intersecting roadways between Highland Avenue/Medford Street and Poplar Street, a different methodology was used to establish growth rates to account for the elevated structure. The CTPS outputs for this

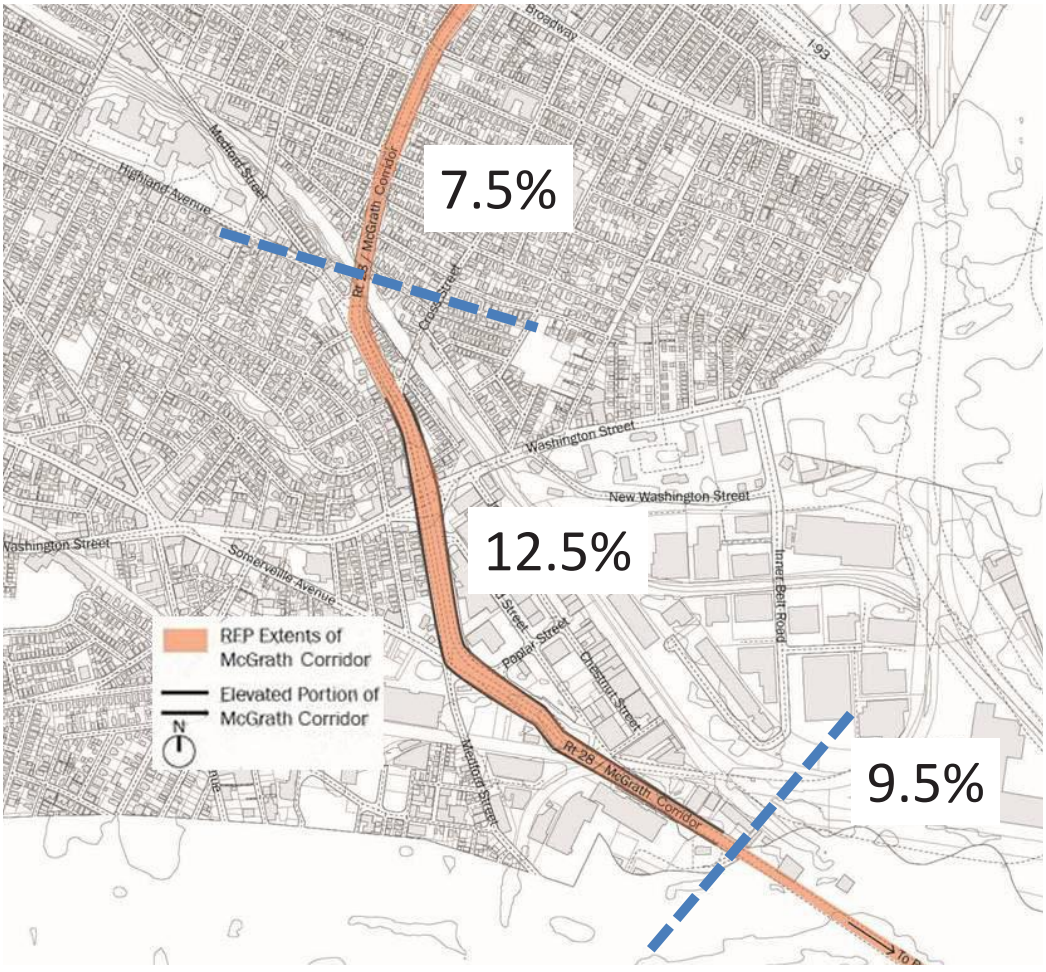


Figure 3-3: McGrath Corridor Traffic Growth Rates

segment were averaged separately for the McGrath corridor elevated roadway and the McGrath ramps. The growth rates generated by CTPS for Washington Street, Somerville Avenue, Medford Street and Poplar Street were each rounded to the nearest half percent. The average growth rate in this segment is 12.5 percent, reflective of the high level of population and employment growth projected for this segment of the McGrath corridor. These averaged McGrath corridor and individual side street growth rates were applied to their respective existing intersection approach volumes to obtain the 2035 No Build peak hour traffic volumes.

- Rufo Road to Land Boulevard. For the study area intersections along the McGrath corridor from Rufo Road to Land Boulevard in the south, the growth rates generated by CTPS for each of the roadway links were rounded to the nearest half percent and applied individually to each of the intersection approaches. The average growth rate for this segment is 9.5 percent.

Based on the outputs from CTPS' regional travel demand model, automobile trips along the McGrath corridor are expected to increase in the range of 7.5 percent to 12.5 percent between 2011 and 2035, depending on the area in the corridor (see Figure 3-3). After applying the calculated roadway link growth rates, the resulting traffic

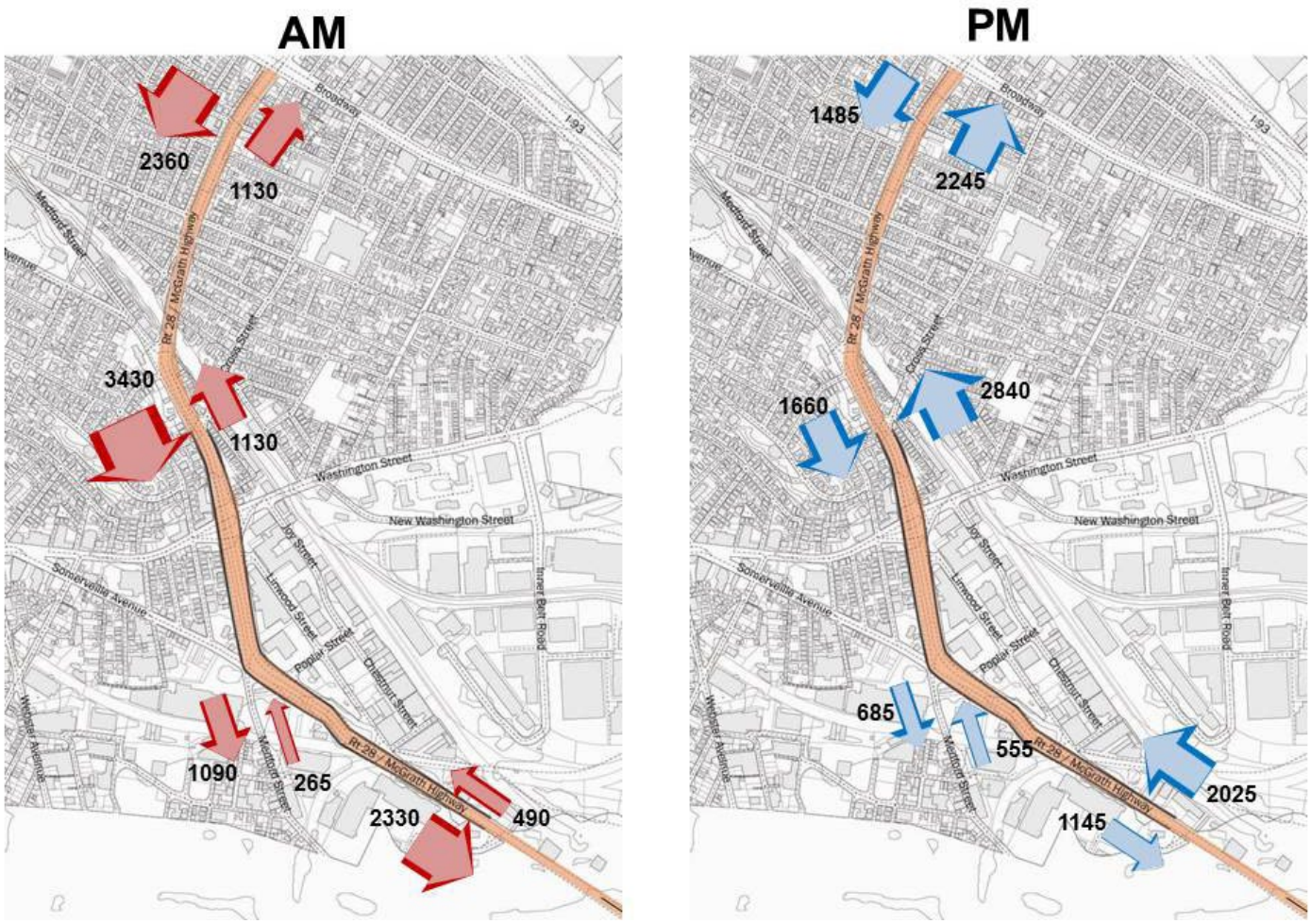


Figure 3-4: Projected Volumes for North/South Segments

volumes represent the 2035 No Build traffic volumes for the weekday morning and weekday afternoon peak hours.

Figure 3-4 and Figure 3-5 indicate the resulting change in vehicular volume by roadway segment. The lighter color arrows depict the 2011 volumes, while the darker arrows represent the projected 2035 No Build Volumes. The total volume for each segment is provided in bold text.

Figure 3-6 and Figure 3-7 compare the Level of Service (LOS) for the weekday morningand weekday afternoon peak periods for the base year 2011 and the 2035 No Build. A summary table comparing the LOS and queue lengths for 2011 and 2035 No Build is provided in Appendix E.

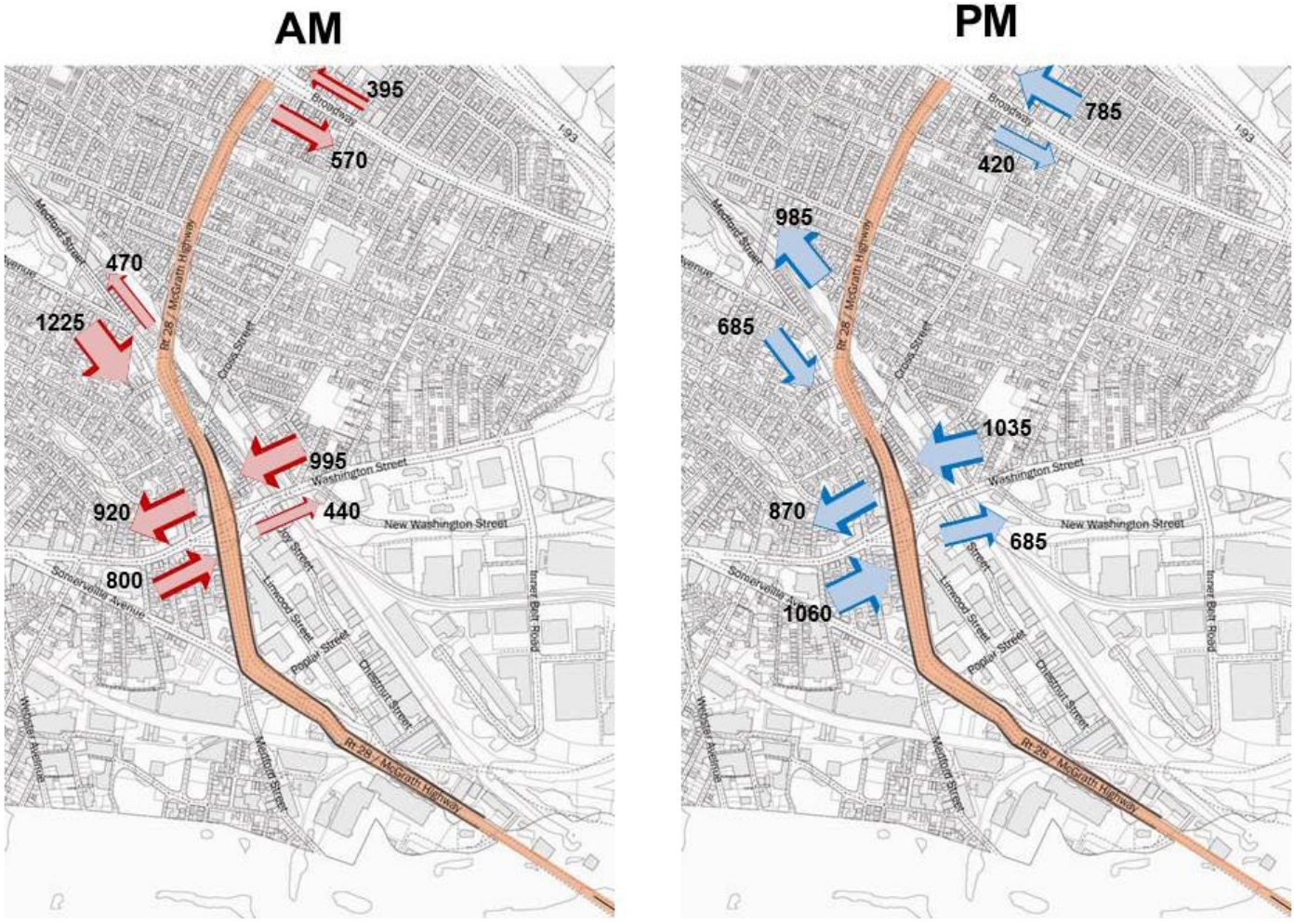


Figure 3-5: Projected Volumes for East/West Segments

Improvements in traffic operations from the 2011 base year to the 2035 No Build conditions are primarily due to assumed optimization of traffic signals in 2035. The slight improvements in the capacity analysis of the No Build scenario are generally a result of minor signal timing adjustments expected to be made in 2035. The changes to the signals are likely to be conducted as part of general signal maintenance and are expected to optimize traffic operations as traffic flows and volumes change over the years. In order to achieve these potential signal timing changes, the traffic signals within the No Build Synchro model were "optimized". No specific modifications were made to signal phasing, equipment or coordination at individual intersections under the No Build conditions. It is also noted that the pedestrian signal improvements implemented by MassDOT in December 2011 for the Washington Street and Medford Street intersections with the McGrath corridor are included as part of the 2035 No Build condition.

Issues and Opportunities

As noted previously the No Build analysis establishes a future baseline against which to compare proposed alternatives presented in Chapters 4 and 5. Many of the issues and opportunities identified in Chapter 2 – Existing Conditions, also apply to the Future No Build condition. In addition to the existing conditions analysis, the following key issues and opportunities from the No Build informed the development of the alternatives:

- As noted in Figure 3-2, population and employment growth in the Inner Belt/Brickbottom area of Somerville is expected to more than double from 2009 to 2035. This growth is expected to have a significant impact on the trips projected to and from that area in the form of new transit, automobile, and non-motorized (bicycle and pedestrian) trips.
- The regional travel demand model assumes transit projects such as the Green Line Extension (GLX) and Assembly Square Orange Line Station are in place. As a result, there is projected to be an increase in transit mode share in the corridor for the future year of 2035 of approximately 5 percent in AM peak period, and about 3 percent increase of transit share in the PM peak period.
- Based on the outputs from the regional travel demand model, automobile trips along the McGrath corridor are expected to increase in the range of 7.5 percent to 12.5 percent between 2011 and 2035, depending on the area along the corridor.
- There are some improvements in level of service (LOS) for intersections in 2035 compared to existing conditions. This is primarily due to assumed optimization of traffic signals in 2035. Intersections with McGrath Highway projected to improve in overall LOS include:
  - » Broadway (PM peak)
  - » Cambridge Street/East Street (AM peak)
  - » Land Boulevard/Austin Street (AM and PM peak)
- Intersections with McGrath Highway projected to decrease in overall LOS include:
  - » Broadway (AM peak)
  - » Pearl Street (AM peak)
  - » Medford Street/Highland Avenue (PM peak)
  - » Somerville Avenue/Medford Street (PM peak)
  - » Cambridge Street/East Street (AM peak)
  - » Land Boulevard/Austin Street (AM and PM peak)
- Intersections with McGrath Highway projected to experience a worsening in overall LOS include:
  - » Broadway (AM peak)
  - » Pearl Street (AM peak)
  - » Medford Street/Highland Avenue (PM peak)
  - » Somerville Avenue/Medford Street (PM peak)

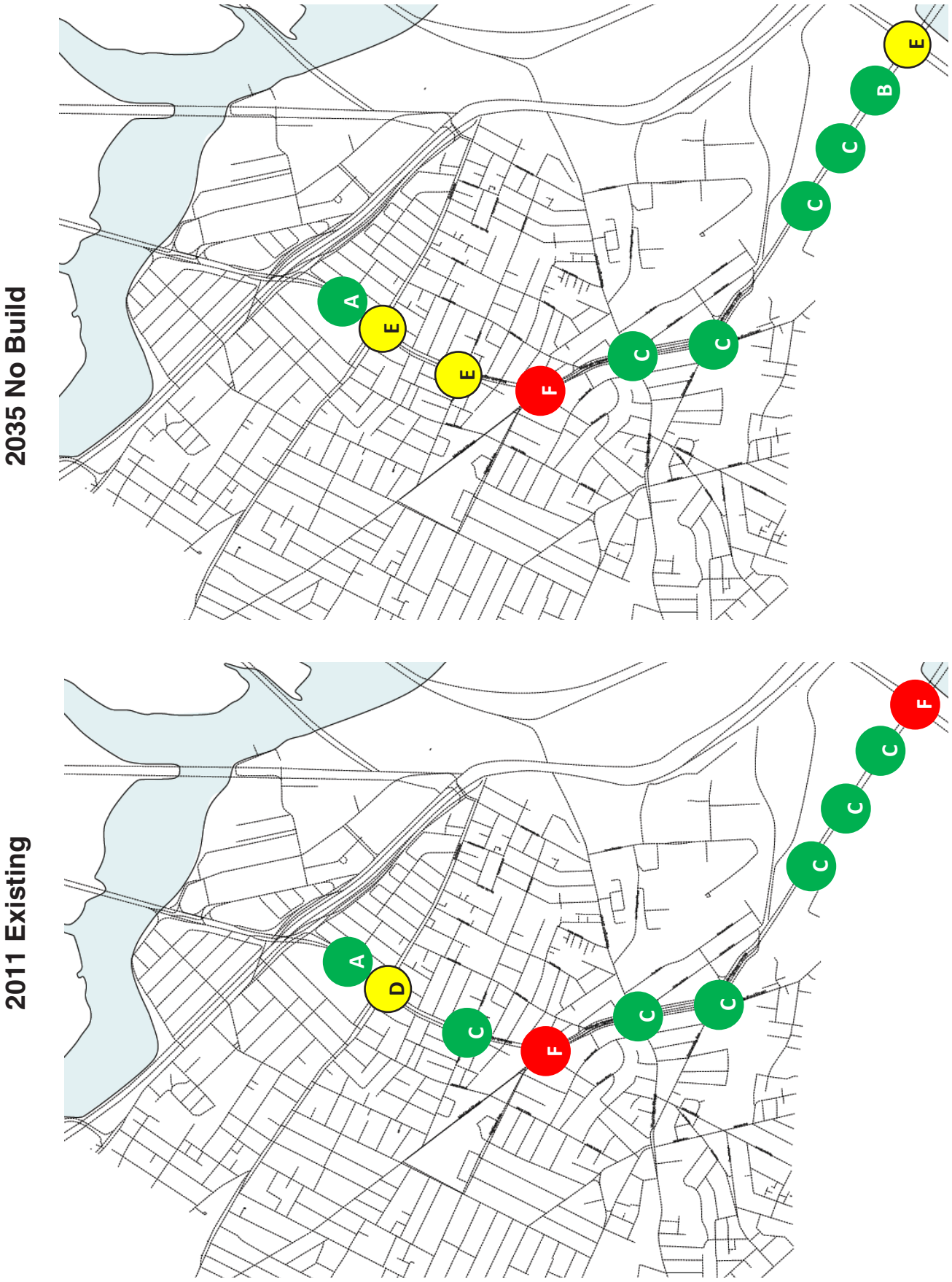


Figure 3-6: LOS 2011 and 2035 Weekday AM Peak

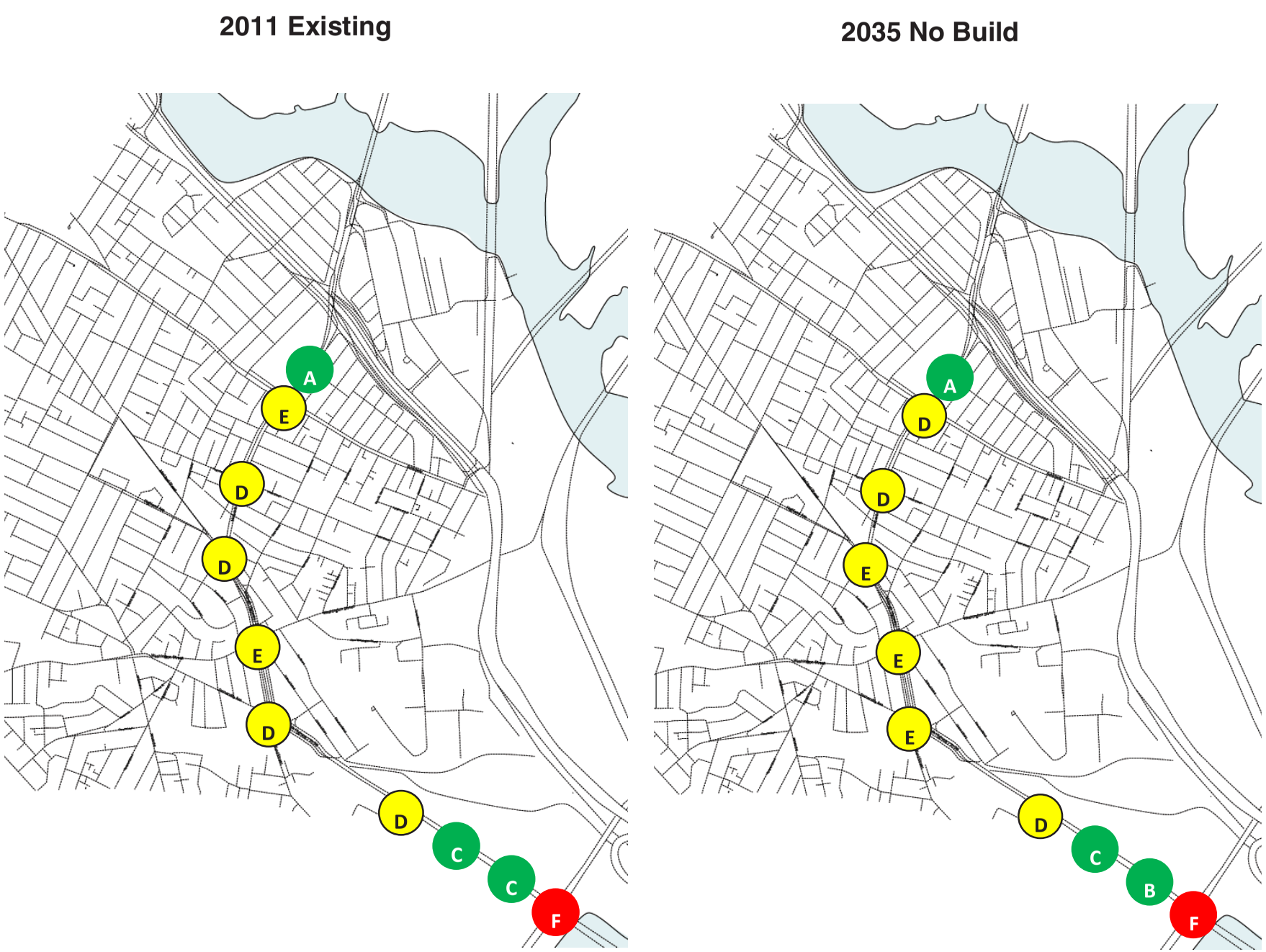


Figure 3-7: LOS 2011 and 2035 Weekday PM Peak

CHAPTER 4: ALTERNATIVES DEVELOPMENT

Introduction

The previous chapters presented the study's purpose and need; goals and objectives; existing conditions in the study area and the resulting transportation issues and concerns; and the expected future conditions. This chapter documents the open and iterative process of conceptualizing specific transportation system interventions intended to address the corridor issues and concerns while pursuing the study goals and objectives, and the steps taken to develop short, medium and long-term alternatives for the corridor.

Alternatives Development Approach and Process

The public involvement process was essential to the development of alternatives. Throughout the early stages of the study and interaction with the Working Group, the project team listened carefully to stakeholder concerns and input. This early civic engagement helped to inform the project team's evaluation of the data and approach to developing alternatives.

At the August 2011 Working Group meeting, members provided detailed input to the project team regarding important connections and problem areas in the corridor that should be considered in the alternatives development task. The Working Group was divided into two groups, each facilitated by a member of the project team. The groups were provided with large roll plans of the corridor and were asked to note issues of importance (see Figure 4-1). A summary of the input received is provided in Appendix G.

Based on the Working Group discussion, the Grounding McGrath study began to transition to the development of alternative alignments. The Grounding McGrath study had a broad mandate to evaluate opportunities and to improve multi-modal travel within the study area. As described in previous chapters, the McCarthy Viaduct is nearing the end of its useful life. At the same time, the areas directly abutting the corridor (Union Square, Inner Belt/Brickbottom) and areas near the ends of the corridor (Assembly Square/NorthPoint) are experiencing significant development demand and opportunities. Meanwhile, the GLX and Somerville Community Path projects are underway, developing multi-modal connections in parallel to the McGrath corridor.

These elements together present a unique opportunity to re-envision the function, alignment, operation, look, feel, and character of the McGrath corridor. With such a broad canvas, the project team developed a staged approach to Alternatives Development. Ultimately, the Grounding McGrath study needed to develop certain alignments that could be developed to sufficient detail to be tested through the regional travel demand model by the Central Transportation Planning Staff (CTPS) and quantitatively analyzed using a range of tools. To take the Working Group through the process of developing and evaluating the potential range of alternatives, a screening approach was taken early in the process to enable consideration of a wide range of alternatives and to eliminate alternatives that did not meet the project goals or that were infeasible.

The process to develop a wide range of general options, and present and understand the issues and opportunities associated with each, was based both on the Existing Conditions work completed and an understanding of the goals and priorities developed during the initial stages of the Grounding McGrath study. These basics come from what MassDOT, project stakeholders, and the community at large defined, and provided the lens through which to view all concepts and alternatives. Even at a conceptual stage, these priorities are driven by the goals established, and defined at an early level by the objectives that support them. While the goals and objectives presented in Chapter 1 provide detailed explanations for these elements, the project team's initial charge was to collaborate with the Working Group to determine how even the conceptual alternatives provided the following elements:

- Greatly improved pedestrian connections to, through and around the McGrath corridor;
- Compatible with the GLX and planned Washington Street and Union Square stations;
- A connection to the proposed extension of the Somerville Community Path;
- A contiguous pedestrian and bicycle path along the McGrath corridor that supports and parallels the Somerville Community Path;
- Improved gateway and multimodal connections to Union Square, especially along the Somerville Avenue approach;
- Consistency with and support for the economic development potential and planning efforts of the Inner Belt/Brickbottom area;

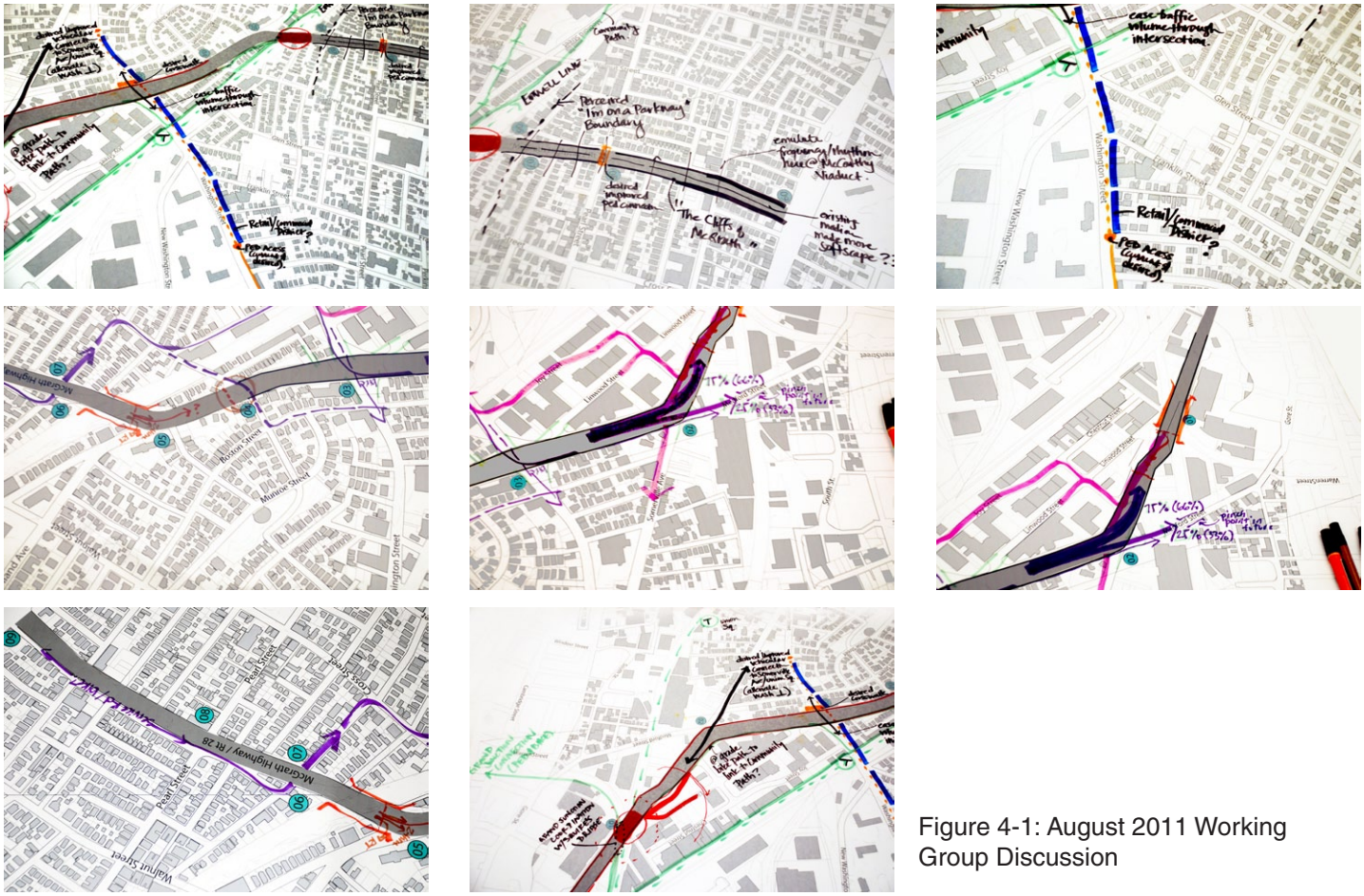


Figure 4-1: August 2011 Working Group Discussion

- Preservation of the sub-regional connectivity provided by the McGrath corridor;
- Maintenance of a level of vehicular carrying capacity consistent with local and regional goals; and,
- Balanced local and regional impacts of all proposed changes.

For the screening level analysis, conceptual alternatives need not be highly detailed to enable the project team and Working Group to understand how they respond to the challenges above. The project team developed the conceptual alternatives only to the level of detail necessary to allow the Working Group to understand if an option merited further analysis or if an option was undesirable. Nevertheless, the conceptual alternatives were also informed by solid planning principles and a review of engineering feasibility.

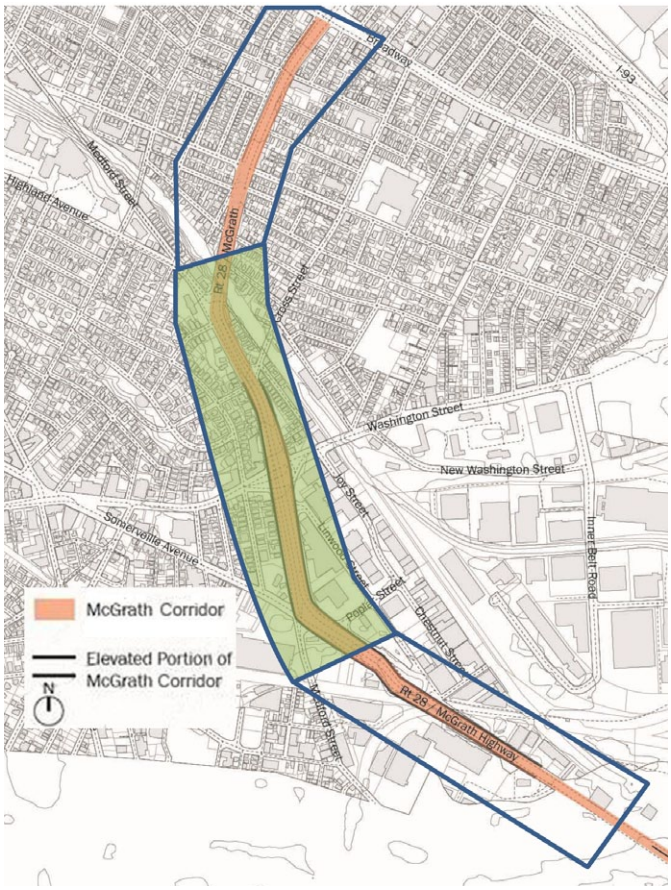


Figure 4-2: Focus Area

Through the Existing Conditions analysis, the Grounding McGrath study identified issues, opportunities and constraints that would drive the alternatives development process. While the issues and opportunities primarily informed the goals and the design approach, the constraints exercise established clear boundaries for feasibility and "fatal flaws." With the GLX transitioning from design into construction, and using the same right-of-way as the existing commuter rail lines, it was quickly established that the Lowell Line and Squire's bridges represented fixed points for the McGrath corridor alignment. These fixed points inherently divided the McGrath corridor into three distinct areas, with the area between the bridges seen as the focus area (see Figure 4-2).

The majority of the elevated structures are in the focus area, whereas north of the Lowell Line Bridge and south of the Squire's Bridge the McGrath corridor is essentially at grade. The community's strongest desire for change, and the greatest opportunity to effect substantive change, is within the focus area. Therefore, initial exercises were focused on understand the challenges within this area and developing a broad range of conceptual alternatives. Meanwhile, for the north and south areas, the Grounding McGrath study developed a range of complementary approaches that could be applied independently from the focus area.

For a long-range planning study, all designs and plans must be responsive to the proposed future horizon year of 2035, the assumptions and conditions of which are described in detail in Chapter 3. Even with the added development, infrastructure, and travel demand forecast for the 2035 year, a fully grounded alternative for the focus area was immediately seen by the Working Group as a desired alternative. However, understanding the implications of at-grade options on a preliminary level was necessary in order to develop approaches to alignment development that would meet these challenges. Thus, the project team undertook a conceptual evaluation of how the focus area of the McGrath corridor would function in the year 2035 if all lanes and ramps were to be "grounded in place."

This "grounded in place" concept was developed to look and function like an at-grade roadway within the current corridor alignment, with a focus on understanding

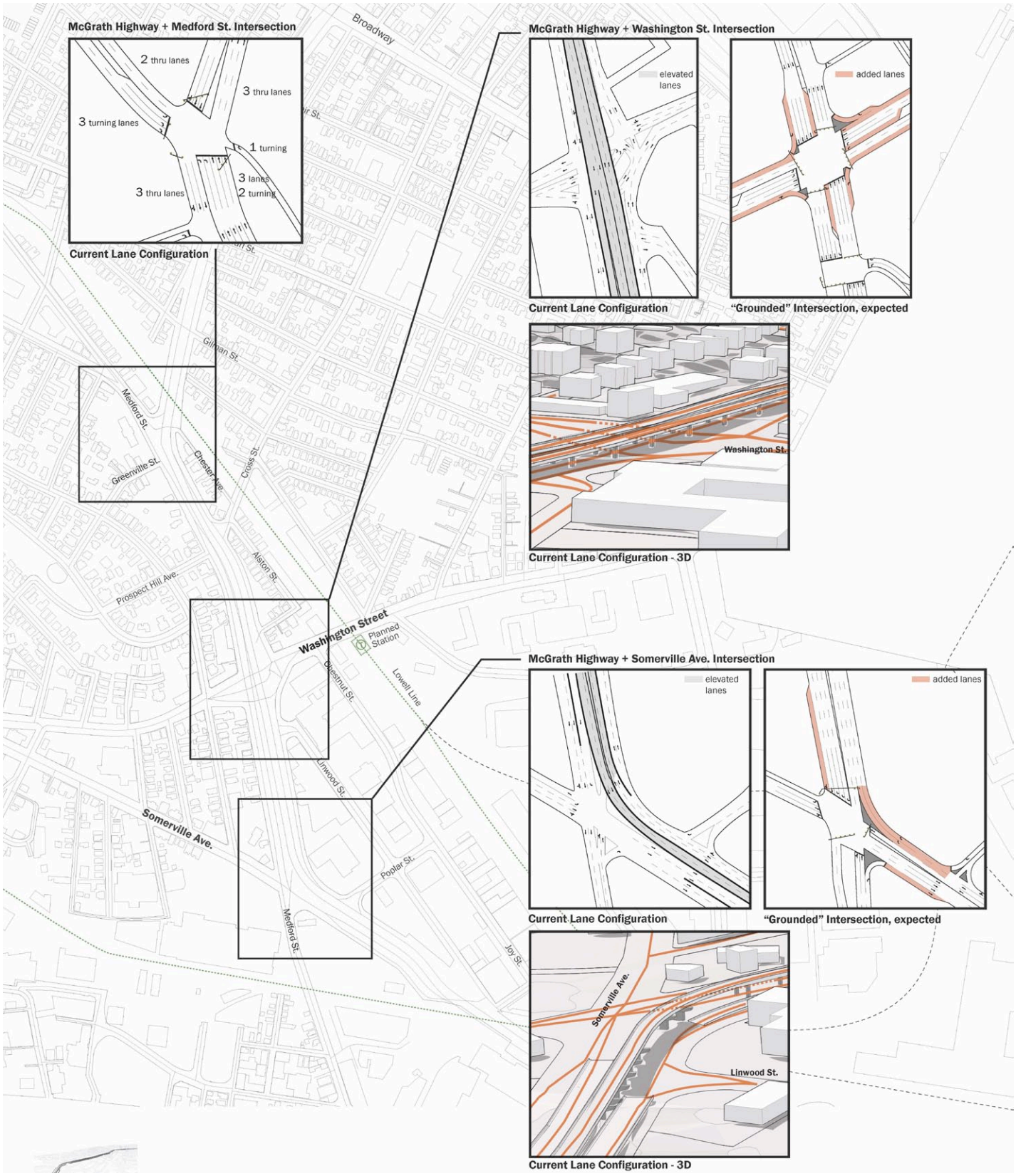


Figure 4-3: Traffic Factors – Lane Comparison at Intersections

overall functionality and identifying potential conflicts so that it could be used as a point of departure for further discussion of at-grade options. The travel patterns and volumes were based primarily on the 2035 Future No-Build transportation conditions developed by CTPS.

It was initially assumed that all turning movements to east/west cross-streets were permitted and that cross traffic did not alter its patterns based on the changed McGrath corridor. This scenario resulted in roadway cross-sections up to eight lanes wide at key intersections, not including additional dedicated turning lanes beyond those that exist today to accommodate new connections created at-grade. While these widened cross-sections could be physically accommodated within the existing configuration of elevated highway, ramps and surface roads, it clearly violated many of the livability, development and connectivity goals and objectives previously described. Figure 4-3: Traffic Factors - Lane Comparison at Intersections provides a graphic representation of how the initial "grounded in place" option was represented.

While this initial concept was assumed to generally accommodate the expected future levels of vehicular traffic, by simply dropping the McGrath corridor to grade with traditional intersections, the following more-specific key challenges were quickly identified and needed to be addressed:

- High turning movement volumes to and from cross streets, particularly at Washington Street, expands the roadway cross-section because of the additional lanes needed to process both through movements and turning movements.
- Due to the McGrath corridor's skewed alignment at the Somerville Avenue / Medford Street intersection, a traditional intersection results in the southbound through movements becoming roughly 2,000 left turns during the weekday morning peak hour.

Based on this first step, a range of overall approaches was developed for the elevated portion of the McGrath corridor, essentially between the MBTA Lowell Line and Squire's Bridge fixed points. Alternatives for the north and south ends of the focus area will be impacted by the choices made in the section that is currently elevated. The northern portion of the study area (north of the Lowell Line Bridge) is currently at-grade, but could benefit from cross-section improvements, described later in this report. The southern portion of the study area (south of the Squire's Bridge) will be informed by the NorthPoint development process in Cambridge.

While neither the future No-Build Alternative nor the "grounded in place" options adequately addressed the study goals and objectives, together they provided a useful basis from which more refined concepts could be further developed that better serve the goals and objectives. Such options were then developed in four general "families" or categories of alternatives:

Keep It:	No Build with structural improvements required for comparison (Future No-Build Conditions)
Move It:	Change the alignment of the McGrath corridor
Bring It Down:	At-grade roadway
Partial Grounding:	A combination of Keep It and Bring It Down options

At the Working Group meeting on December 12, 2011, the members were provided with maps of the project scope and primary intersections along the corridor (see Figure 4-4). Attendees were encouraged to gather around the table to review and provide suggestions to various approaches and options. This resulted in an interactive approach designed to shape a consensus among the project team and the Working Group on which alternatives should receive more in-depth analysis, and which concepts were infeasible or undesirable.

The following sections provide more detail on the concepts developed, as well as the input received that generally guided the alternatives development process.

Keep It Option
The Keep It option is the future No Build Alternative described in Chapter 3.

As described in previous chapters, the McCarthy Viaduct was identified for repairs or replacement as part of MassDOT's Accelerated Bridge Program (ABP). Repair

work to ensure safety, and design of some short-term circulation improvements are underway. As a result of public meetings for the repair work, the City of Somerville and members of the Working Group expressed a strong desire for removal of the McCarthy Viaduct. As a result, MassDOT committed to working with the local community to identify a long-term vision for the corridor that removes the McCarthy Viaduct, while exploring short-term improvements, including the safety and structural stability repairs on the viaduct as well as pedestrian and bicycle access improvements along and across the corridor. Therefore, the "Keep It" option exists as the future No Build condition, against which other options can be compared.

"Take the overpass down. Take it down yesterday,"
Mayor Joseph Curtatone, City of Somerville

"We are as committed as the community is to removing the McCarthy overpass, and redesigning and reconstructing this corridor, so that it is part again of your community,"
Frank DePaola , MassDOT Highway Administrator

"Fix Now, Flatten Later"
Somerville Journal, June 6, 2012

Figure 4-4: December 2011 Working Group Meeting

Move It Option
This option evaluated the possibility of relocating all or part of the McGrath corridor outside of the current alignment, but still retaining the fixed points at the Squire's and Lowell Line bridges. As it evolved, an alternative that assumed the separation of the north and southbound portions of the corridor was developed. In this case, the northbound portion and function of the McGrath corridor is explored for relocation in an alignment within the adjacent Brickbottom area to the east of the McGrath corridor. The primary objectives of this option were to:

- Promote access, connectivity, and economic development potential for the Brickbottom area of Somerville.
- Establish a separated road boulevard with a developable or large/wide useable central area, similar to the Rose Kennedy Greenway in Boston.

As part of presenting this alternative, variations of this concept included moving the northbound elevated portion of the McGrath corridor to touch down at a point on Joy Street in the vicinity of Poplar Street. The northbound McGrath corridor would then "take off" onto another elevated structure that would pass over Washington Street, similarly to how the existing northbound move works within the corridor alignment today. This approach opened a range of possibilities, defined only by the restrictions of where the touch-down and take-off locations of ramps from the fixed points could land. Conceptual engineering showed that these were dependent on the alignment and potential design speed for the ramp. To demonstrate the possibilities, this concept examined design speeds[1] of 35 mph, 40 mph and 45 mph in a range of different alignments. The corresponding touchdown and take-off locations are shown graphically in Figure 5: Speed and Structure Factors - Rotational Range of On/Off Ramps.

Working Group participants expressed the following primary concerns about the "Move It" option:

- The need for acquiring additional right-of-way and associated potential negative impacts on the Brickbottom area.
- High cost and time that it would take to implement this option as a result of right-of-way issues.
- Limited access to Union Square from the northbound McGrath corridor.
- Difficulty in navigating one-way pairs of roadways for newcomers and visitors to the area.
- Disjointed pedestrian and bicycle connections, especially across Washington Street.
- Separation of transit access, but with a northbound move closer to the planned GLX station at Washington Street.
- Potential need for ramps and difficulty defining the relocated northbound McGrath corridor in relation to Washington Street.

Partial Grounding Option
Consideration was also given to retaining only part of the McCarthy Viaduct by maintaining an elevated structure near Somerville Avenue, and over Washington Street, but providing an at-grade roadway in between the two points. Maintaining part or all of these structures and seeing how much of the corridor could be transitioned to an at-grade roadway for the segment between these two points was explored. The Partial Grounding option would keep the McGrath corridor in its current corridor alignment, but still retain some of the challenges explored in the Move It option. The fixed points of the Squire's Bridge and the Lowell Line Bridge still require a substantial distance to reach grade, even at moderate design speeds. Therefore, only a short length of the McGrath corridor would be at-grade between the Squire's Bridge and a Washington Street bridge due to the length of the ramps that would be required. See Figure 4-6: Speed and Structure Factors - Touchdown Points.

Points
If the elevated structure were retained to cross only one of the two primary intersections of Washington Street or Somerville Avenue, a somewhat greater length of at-grade roadway could be developed for the McGrath corridor. However, the lengths of ramps required would continue to limit the total area of the McGrath corridor that could be at-grade in between the two points. The need to retain the Squire's Bridge to cross the railroad tracks limits the touchdown points in the vicinity of Poplar Street and Somerville Avenue.

1 The design speed for the ramp is the maximum safe speed for the facility, and is typically about 10 mph above the posted speed.

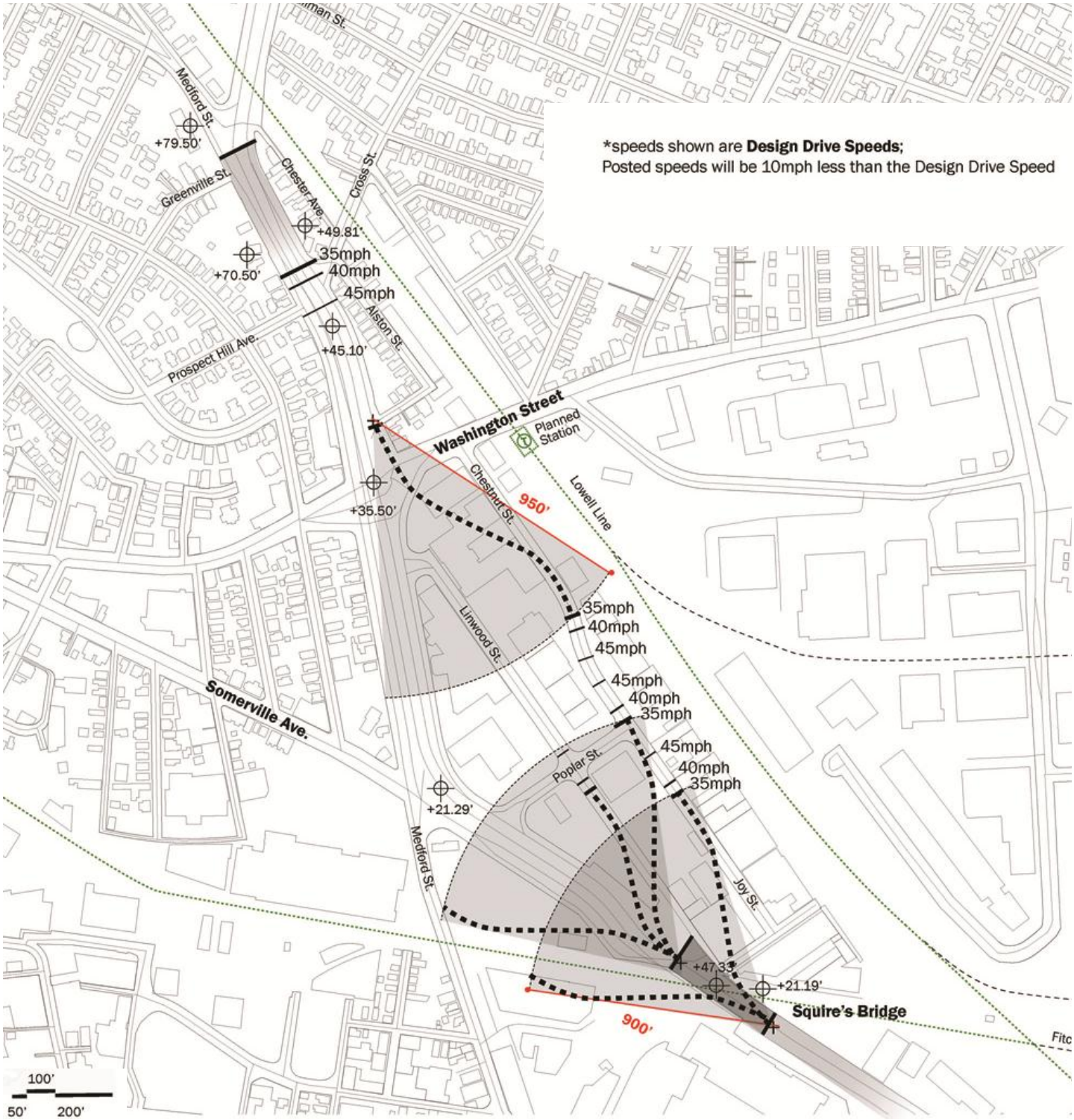


Figure 4-5: Speed and Structure Factors - Rotational Range of On/Off Ramps

*speeds shown are **Design Drive Speeds**;
Posted speeds will be 10mph less than the Design Drive Speed

Figure 4-6: Speed and Structure Factors - Touchdown Points

The Working Group did not support this option due to the following primary concerns:

- A substantial amount of elevated structure was retained in this concept, which would continue to serve as a barrier and therefore not achieve many of the project goals and objectives, such as improving local access and connectivity.
- A clear stated preference to minimize structures to the extent possible for connectivity, aesthetics, and development preferences.

At the concept development stage, MassDOT agreed to table discussion on any Partial Grounding options in pursuit of a full grounding option, and to revisit partial grounding only if an at-grade solution proved to be infeasible.

Bring it Down

The final approach evaluated options that eliminated as many structures and ramps as possible within the McGrath corridor area. This "Bring it Down" approach expanded on the initial "grounded in place" scenario to attempt to work through the connectivity and design challenges that occur by assuming a fully at-grade solution between the Squire's and Lowell Line bridges. As described in the other concepts, the locations where existing fixed high points could touch down to grade were taken as a starting point. See Figure 4-6: Speed and Structure Factors - Touchdown Points.

Natural changes in the topography created additional challenges for a fully at-grade solution. This is particularly true in the McGrath corridor section between Washington Street and Medford Street/Highland Avenue. At the Medford Street/Highland Avenue intersection with the McGrath corridor, the roadway is not elevated, but is at-grade at a point well above Washington Street. There is a substantial change in topography as Prospect Hill slopes down from west to east across the corridor and down to the Lowell Line tracks, thereby making connections across the McGrath corridor difficult to accommodate.

To explore the "Bring It Down" option, individual configurations were conceptually drawn to test various possibilities at each intersection in the focus area, as well as connectivity in the larger area. A general overview of vehicular, transit, pedestrian, bicycle, and aesthetic concerns could then also be discussed through each option. A series of at-grade lane configuration concepts were developed for discussion with the Working Group, which focused on the intersections of the McGrath corridor with Somerville Avenue and with Washington Street.

Since one of the primary purposes of the elevated McCarthy Viaduct of the McGrath corridor is to carry vehicles over Washington Street and Somerville Avenue in free-flow conditions, the alternatives development process needed to focus on options and solutions that accommodate both side street and McGrath mainline traffic at intersections. Instead of the complex system of ramps and surfaces streets that exist today, the options focused on potential surface intersection designs at:

- Somerville Avenue
- Washington Street
- Focus area between Washington Street and Somerville Avenue

Those designs deemed undesirable were eliminated, and those with promise carried forward into more realized design refinements. The intersections and the conceptual variations are discussed in greater detail in the following sections.

Somerville Avenue Intersection Options

Developing an alternative for the intersection of the McGrath corridor with Somerville Avenue is challenging due to the complicated intersection alignment and offset signal timing needed for an at-grade intersection with five approaches, four of them major, high-volume roadways. The series of options for the Somerville Avenue intersection with the McGrath corridor were developed in an attempt to:

- Improve connections between the McGrath corridor, Somerville Avenue, Poplar Street, and Medford Street.
- Provide new connections - for vehicles, pedestrians, and bicyclists - that do not currently exist.
- Open up access to the Brickbottom area as it is poised to develop.
- Clarify and simplify pedestrian crossings
- Maximize the potential reclaimed area from the

rights-of-way.
- Maintain a level of traffic flow through the area.

The options evaluated are described below:

Somerville Avenue 3-Leg Intersection (See Figure 4-7):
In this option Poplar Street would be extended west of the McGrath corridor to intersect with a new alignment of Somerville Avenue that does not intersect with the McGrath corridor. This would reduce southbound conflicts on the McGrath corridor with Somerville Avenue and create access to Inner Belt/Brickbottom. This configuration, however, would also create two closely-spaced, high-volume signalized intersections, with heavy conflicting traffic flows.

Poplar Street 4-Leg Intersection (See Figure 4-8):
In this option Somerville Avenue and Medford Street would be realigned to create two separate intersections with the McGrath corridor. This option would create access to Inner Belt/Brickbottom and Medford Street.

Somerville Avenue 3-Leg Roundabout (See Figure 4-9):
In this option, Somerville Avenue and Medford Street are directly connected by a roundabout west of the McGrath corridor. A short roadway section just north of Poplar Street would provide access from the roundabout to the McGrath corridor via a signalized intersection. This option would reduce left-turn conflicts from Somerville Avenue and the McGrath corridor, but would not provide access from the McGrath corridor southbound, Medford Street, or Somerville Avenue to Brickbottom.

Washington Street Intersection Options
The major challenge at the intersection of Washington Street with the McGrath corridor is to process the high east/west traffic volumes on Washington Street. In a grounded solution the east/west volumes would be in conflict with the heavy north/south volumes on the McGrath corridor. Overall improvements for this option must consider the following concerns and desires;
- Accommodating turning movements, especially from Washington Street, which connects Union Square to Sullivan Square.
- Providing a strong pedestrian connection to the

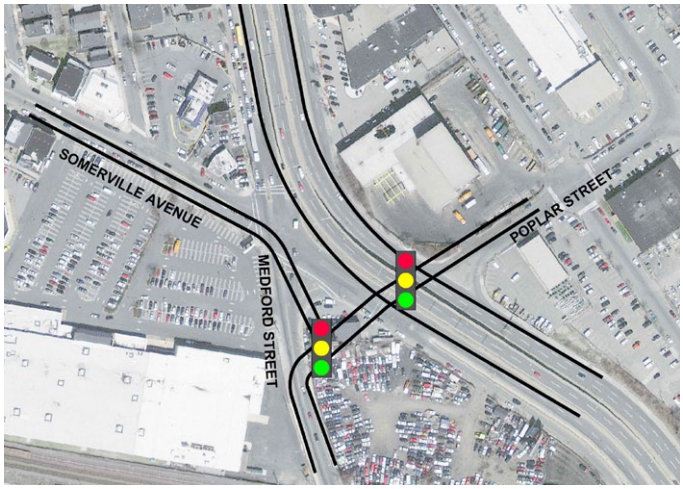


Figure 4-7: Somerville Avenue 3-Leg Intersection

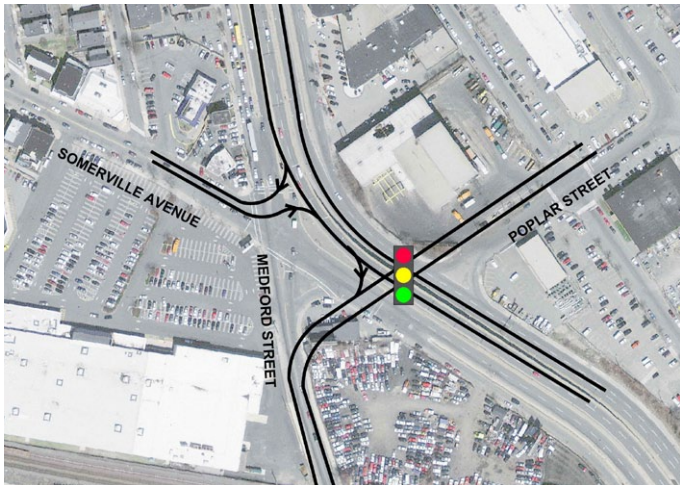


Figure 4-8: Poplar Street 4-Leg Intersection

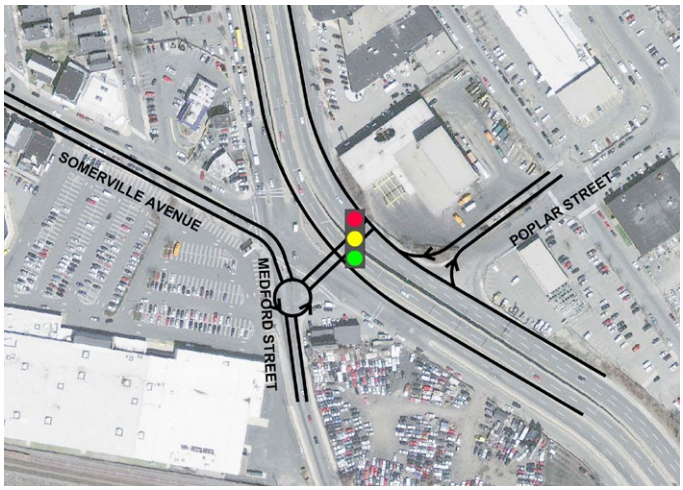


Figure 4-9: Somerville Avenue 3-Leg Roundabout

proposed Washington Station on the Green Line extension.
- Creating a gateway to Union Square.
- Providing for development potential along the north and west edges of Brickbottom.
- An already difficult east-west pedestrian crossing at the intersection must be configured to cross pedestrians against traffic volumes that include surface and previously elevated vehicles.

The options evaluated are described below:

Traditional Intersection with Turn Restrictions (See Figure 4-10):
This option signalizes the intersection of Washington Street with the McGrath corridor, but eliminates left turns from the McGrath corridor, thus removing certain conflicting movements at Washington Street. The left turning vehicles would need to find a new route to their destination.

Jughandle Intersection (See Figure 4-11):
This option would include the creation of a jughandle, or partial diamond, at the Washington Street intersection with the McGrath corridor to accommodate the left-turns onto Washington Street, removing those turns from the central signalized intersection.

Median U-turn Intersection (See Figure 4-12):
This option removes the left-turns from the McGrath corridor onto Washington Street signalized intersection, and accommodates those turns through mid-block U-turns. For example, northbound traffic that wishes to turn left from the McGrath corridor to head westbound, would instead pass straight through the intersection and then perform a U-turn to go in the southbound direction and then turn right at the Washington Street intersection to head westbound. In this option, the mid-block U-turns would be signalized, which would create additional pedestrian access across the McGrath corridor north and south of the intersection.

Focus Area Options
While maintaining circulation and connectivity at the Washington Street and Somerville Avenue intersections with the McGrath corridor for all modes is challenging, bringing the McGrath corridor down to grade also opens opportunities to realign a new at-grade segment between

Figure 4-10: Washington Street - Traditional Intersection with Turn Restrictions

Figure 4-11: Washington Street - Jughandle Intersection

Figure 4-12: Washington Street - Median U-turn Intersections

the two intersections. The following other changes to overall circulation between Union Square, the McGrath corridor, Inner Belt/Brickbottom, and other regional destinations were also explored:

- Traditional Intersections (See Figure 4-13): Both intersections would be signalized with a new connection between Somerville Avenue and the northbound McGrath corridor.
- Double Roundabout (See Figure 4-14): Both intersections configured as roundabouts. This option would also provide a new connection between Somerville Avenue and the northbound McGrath corridor. Based on projected traffic volumes for 2035, this option may exceed capacity of a three lane roundabout.
- One-Way Pair (See Figure 4-15): West of the McGrath corridor, Washington Street would become one-way westbound and Somerville Avenue would become one-way eastbound.

Working Group Feedback

Based on the concept diagrams, Working Group participants provided the following feedback on the preliminary concepts for the "Bring It Down" options:

- Bicycle and pedestrian accommodations need to be fully integrated; these modes should be fairly considered on an equitable footing with motor vehicles.
- The alternatives analysis should include a traditional boulevard with a "road diet" option, and the impacts of potential trip diversion that may occur as a result of providing a reduced capacity along the McGrath corridor need to be understood.
- Preference should be given to local traffic over regional traffic access.
- The Accelerated Bridge Program interim repairs for the McCarthy Viaduct should be used as a test for traffic diversion to incorporate in the alternatives analysis.
- The projection that a roundabout would require more than three lanes of traffic is not consistent with community development goals. A combination of signals and roundabouts may provide better design options for locations where roundabouts are considered.
- Connections to Poplar Street are important for the future access to Brickbottom.
- Efforts to reduce roadway cross-sections, while providing new pedestrian connections, are desirable. For example, prohibit left turns if it results in fewer lanes at the intersection approach.
- Connections to and from Union Square are very important in achieving the vision of the future for the City of Somerville.

Figure 4-13: Focus Area - Traditional Intersections

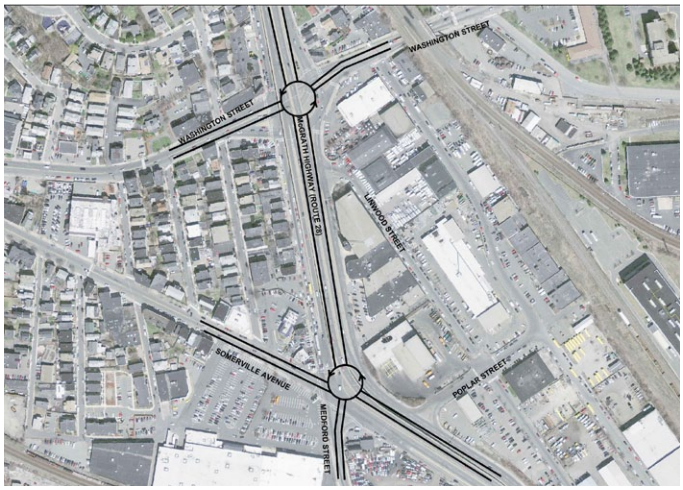


Figure 4-14: Focus Area - Double Roundabout

Figure 4-15: Focus Area - One-Way Pair

Refinement of Alternatives

The Working Group provided extensive feedback on the concepts presented at the December 2011 meeting, and expressed preferences for which alternatives should be refined further.

The "Move It" option was eliminated from further discussion as it was too disruptive to potential Brickbottom development, required additional right-of-way, and it would create challenges at Washington Street with the potential need for ramps and difficulty defining the relocated northbound McGrath corridor in relation to Washington Street.

The "Partial Grounding" option was tabled in favor of further development of fully at-grade solutions. With the Health Impact Assessment taking shape, and ongoing MassDOT communication around the short-term repairs, the Working Group preference was to explore "Bring It Down" options, in keeping with the larger community vision of a connected, walkable, balanced corridor.

One of the primary goals of the Grounding McGrath study is to balance the impacts and benefits of local and regional transportation. A more congested McGrath corridor may be acceptable if it provided greatly improved connectivity, circulation and sense of place, as well as reasonable regional mobility. This end was felt to be best achieved through an at-grade alternative. The preliminary concepts provided enough detail to understand the challenges, and the project team and Working Group agreed that workable designs could likely emerge through further effort and discussion.

Process

The alternatives refinement process began by developing a series of at-grade approaches in the focus area. Ultimately, three alternatives were to be carried through the CTPS regional travel demand model for evaluation and testing. Based on the previous focus area alignment options, the project team created four basic alternatives that advanced these concepts in an attempt to show the distinctions between them. Working Group discussion could then explore the implications and discard, extend, or combine these approaches as needed for further testing. With transformative change (in the form of grounding) proposed, the CTPS modeling would provide further feedback that could be incorporated into the design and alternative evaluation process.

The three alternatives would need to be developed and designed sufficiently to provide all model inputs, including the multimodal connections that would be enhanced or severed, basic intersection operations, and transit routing. Each concept was further developed through a preliminary assessment using the Synchro traffic analysis software program. This allowed the project team to further develop the concepts and provide inputs – such as the number of lanes, lane assignments and roadway connections – for further regional travel demand modeling described in Chapter 5.

Assumptions

As these initial alternatives were not intended to be final, certain assumptions were made at the outset for all alternatives. Individual alternative approaches also required more specific assumptions, which are defined subsequently. Overall, for each alternative:

- No adjustments were made for redirected or shifted traffic in or around the corridor.
- Basic signal phasing and timing were used for initial capacity analysis.
- The McGrath corridor should remain within the existing right-of-way to the greatest extent possible.
- Concepts are shown varyingly aligned on the east or west side of the existing right-of-way, but could be shifted during refinement to best meet goals and objectives of the project.

- Pedestrian and bicycle connections are shown and presumed, but not defined to a level of design detail at this stage. The presence of connections alone is a sufficient input into the CTPS model.
- Space within the right-of-way that is not needed for vehicular circulation/paved area is shown in green. Further refinement of a preferred design will determine what portions of the space would be used for sidewalk, on-street parking, bicycle accommodations, green space, development or any other desired use.
- All of the alternatives assume a continuous pedestrian and bicycle connections along both sides of the McGrath corridor and across the corridor at all major intersections.

The range of refined options and the key assumptions, issues, and opportunities were presented to the Working Group on March 7, 2012. These options were refined to develop more specific alternatives and included the following:

- Signalized Rotaries
- Median U-turns
- Access Roads
- Boulevard

Signalized Rotaries
This alternative included two signalized rotaries, one at the Washington Street intersection with the McGrath corridor, and one at the McGrath/Medford Street/ Somerville Avenue intersection. As shown in Figure 4-16, the mainline northbound and southbound through movements on the McGrath corridor would pass through the center of each rotary. The McGrath corridor and other new roadways would generally remain within the existing right-of-way, but with potential property impacts as determined by the size and radii of the rotary. Pedestrian and bicycle connections would occur along the roadway, and crossings would be at the signal locations. The level of expected vehicular volumes on the McGrath corridor would require signalized rotaries, rather than traditional roundabouts. Utilizing signalized rotaries in place of a traditional intersection separates the left turning traffic from the primary intersections, helping reduce overall traffic delay.

Poplar Street would be relocated slightly north of its current location. This relocation impacts a parcel currently occupied by Waste Management, Inc. but owned by the City of Somerville. The alignment of Poplar Street at Linwood Street could be angled southeast to meet the current alignment, or extended to meet the proposed crossing under the Green Line tracks to access the Inner Belt District. See Figure 16: Signalized Rotaries Option.

Opportunities
- Allows for a narrower mainline on the McGrath corridor, providing the ability to create wider spaces for parks and pedestrian and bicycle access.
- Creates new access from the McGrath corridor northbound to Somerville Avenue and Union Square.
- Allows travel to/from each major roadway intersecting the McGrath corridor, facilitating new connections that are not possible under the existing or future No-Build traffic conditions.
- Allows for full access to the McGrath corridor from Poplar Street and the Brickbottom area. Full access is not currently available today or under the future No-Build scenario.
- There is potential for landscaping and green space inside the rotaries to strengthen visual character and create a sense of place.
- Opportunities are presented to enhance visibility for businesses along the McGrath corridor, with options for new architecture to define the rotary edges with pedestrian networks and building facades.
- Pedestrians could cross concurrently with vehicles at most signalized intersections.

Identified or Potential Issues
- Allowing left-turns from the rotaries onto the McGrath corridor may cause vehicle queues on the circulating lanes to block other traffic movements. Addressing this would require that left-turns from cross street traffic be processed as circular moves (270 degree movements), similar to existing conditions at the intersection of Washington Street and the McGrath corridor.
- Lane configurations for the intersection of Linwood Street with the McGrath corridor would be challenging:

Figure 4-16: Signalized Rotaries Option

  - » The right-turn in and right-turn out only movements from Linwood Street may be too close to the Washington Street rotary for it to function properly.
  - » The right-out only restrictions from Linwood Street would likely result in traffic diverting to Poplar Street where full access to the McGrath corridor is provided via the rotary.
  - » Linwood Street traffic could be rerouted to Joy Street, but this could require new traffic control at the Joy Street/Washington Street intersection to accommodate the increased volumes.
  - » Convert Linwood Street to one-way south from the McGrath corridor toward Poplar Street to reduce conflicts with turning movements from Linwood Street onto the McGrath corridor.
- Providing direct east/west pedestrian connectivity along Washington Street across the McGrath corridor is a challenge. An additional pedestrian signal could be added through the center of the rotary, changing the balance of operations, as pedestrian crossing distances and wait times would be reduced. However, vehicular delay, and potentially the number of lanes would grow. Pedestrian crossings that follow the circular roadway would result in longer walking distances to cross the McGrath corridor.
- This alternative results in a wider right-of-way at Washington Street and at Somerville Avenue, with potential impacts to private property.
- Specific bus stop locations need to be considered in the area of the rotaries to facilitate transfers between routes and different modes of transportation.

Median U-turns

The Median U-turn option attempts to eliminate all left-turns from the main McGrath corridor intersections, to simplify their operations, shorten the pedestrian crossings and minimize their overall footprint. All left-turns from Washington Street and the McGrath corridor would be processed as U-turns at adjacent intersections north and south of that intersection. For example, traffic wishing to turn left from the McGrath corridor northbound to Washington Street westbound would have to pass through the intersection, make a U-turn at the McGrath corridor/Cross Street/Prospect Hill Avenue intersection, and then turn right onto Washington Street westbound. This alternative would also provide new signalized pedestrian crossings at the points where the U-turns are accommodated. See Figure 4-17: Median U-turns Option. Turning radii of U-turns are conceptual. A center median will be required to accommodate a sufficient turning radius.

This alternative also included the conversion of the Medford Street/Highland Avenue eastbound approach movements to the McGrath corridor to all right turns (eliminating the left-turn move to McGrath northbound) and utilizing the U-turn to make that move. The intent was to improve the vehicular level of service at the intersection without changing the roadway width, and to add a protected pedestrian crossing. Access to the McGrath corridor northbound would be provided via a U-turn at the Cross Street/Prospect Hill Avenue intersection. This option is further explored in the next section for potential improvements of the McGrath corridor north of the Lowell Line Bridge.

Opportunities

- Allows for a new signalized pedestrian crossing at Cross Street. Pedestrians would cross on the north side of the intersection concurrently with the northbound to southbound McGrath corridor U-turn.
- Allows for a new signalized pedestrian crossing between Linwood and Somerville Avenue. Pedestrians would cross on the south side of the intersection concurrently with the McGrath southbound to northbound U-turn.
- The new intersection north of Washington Street could also serve the left turns from Medford Street/ Highland Avenue as a southbound to northbound U-turn. This would improve traffic operations at the Medford/Highland/McGrath intersection without geometric changes to the intersection. However, this change needs to be balanced with the intersection operations at Cross Street (described below).

Identified or Potential Issues

- There is the potential for a “dual U-turn” in the vicinity of Cross Street to accommodate both northbound and southbound vehicle turns. This dual U-turn intersection which would require an all pedestrian phase to safely allow for pedestrian crossings which would provide added delay to the traffic on the McGrath corridor, and potentially creating longer

Figure 4-17: Median U-turns Option

queues at the closely spaced intersections.

- Further assessment of the impacts to cross-streets such as Prospect Hill Avenue, Chester Avenue, and others is necessary, as connections across the corridor may be possible in this alignment, but not desirable for topography, access and safety reasons. Vehicular right-in/right-out is assumed for Greenville Avenue and Prospect Hill Avenue.
- Vehicular access to Brickbottom continues to be limited with a right-in, right-out access at Linwood and Poplar Streets, with access from Brickbottom to the southbound McGrath corridor via the U-turn.
- Heavy southbound volume on the McGrath corridor at Somerville Avenue could require at least three right-turn lanes for this scenario, making pedestrian crossings longer due to the added overall roadway width.
- McGrath corridor northbound traffic must continue to use a U-turn movement to access Somerville Avenue, not unlike existing operations.
- Providing signalized intersections for the U-turn movements leads to the creation of four closely-spaced intersections along the McGrath corridor (at Washington Street, Linwood Street, the median U-turns, and Somerville Avenue) which may result in spillback issues for vehicle queues that would then create gridlock along the corridor.
- Provides new connections compared to the future No Build conditions, but the turning lanes required result in a wide cross-section for each of the new at-grade intersections.
- While potentially simplifying the main intersections, this option does not offer a defining element that would contribute to a strong sense of place. The U-turn intersections would also be wider in between the main intersections reducing the amount of open space and developable sites available along the corridor.
- There are limited options for developing pedestrian and bicycle access along the corridor due to the wider roadway width required for the U-turn segments.
- The additional intersections potentially limit the ability to provide on-street parking along the McGrath corridor blocks.
- New bus stop locations would need to be identified, and certain bus route moves may require the use of the U-turns.

Access Road

In this alternative, an access road parallel to the McGrath corridor would be constructed along the western edge of the corridor between the Washington Street and Somerville Avenue/Medford Street intersections. This access road would be designed to accommodate vehicular traffic accessing Washington Street, Somerville Avenue, and Medford Street. Processing the local traffic along this access road allows the mainline McGrath corridor cross-section to be significantly narrowed. Northbound circulating traffic would be diverted through the Brickbottom area in lieu of a parallel access road. Two options were developed for this alternative, using either Joy Street (Figure 4-18) or Linwood Street (Figure 4-19). Similar to the prior options, Poplar Street could be relocated slightly north of the current location to connect to the McGrath corridor via a new at-grade intersection. Required turning radii of the access roads' connection to the McGrath corridor were not determined for this phase of analysis, but would be assessed if this option advanced for further consideration.

Opportunities

- Under this alternative the number of lanes on the southbound access road that parallels the McGrath corridor has been reduced because the improved access to Somerville Avenue allows for the potential shift in trips originating in Union Square to Somerville Avenue eastbound from Washington Street. This may also result in more balanced traffic demand between Washington Street and Somerville Avenue.
- The northbound access road incorporated through the existing Brickbottom area roadways would potentially enhance access for economic development.
- The northbound and southbound mainline of the McGrath corridor could be narrowed to two lanes in this alternative, expanding to three only when additional vehicle storage is needed at the intersection approaches.

Figure 4-18: Access Road Option - Joy Street

Figure 4-19: Access Road Option - Linwood Street

Identified or Potential Issues

- The unbalanced higher demand for southbound travel requires the southbound access road to be two to three lanes in width. The higher southbound traffic volumes are a function of traffic:
  - » Destined to Medford Street
  - » Washington Street eastbound left-turns that are removed from the intersection (to narrow it and improve operations) but would use the access road to get to the northbound McGrath corridor.
- Washington Street eastbound cross-street traffic exceeds capacity with the two-lane southbound access road during the PM peak period.
- Washington Street through traffic would be forced to drive a longer distance through three signals, since the through movement is shifted to the north of the existing Washington Street alignment, compared to the future No-Build.
- The proximity of the McGrath/Somerville Avenue/ Medford Street/Poplar Street intersection to the projected "touchdown" point from the Squire's Bridge is problematic for northbound traffic's lines of sight, and for providing the physical and geometric connections to Somerville Avenue.
- The circular pattern of the access roads creates circuitous east-west connectivity throughout the corridor, particularly northbound McGrath corridor access to Union Square.
- Buses would be separated with some using the access road and some using the mainline, making co-location of stops difficult.
- Wide circulating patterns, with very wide overall cross-sections would be created, resulting in:
  - » Limited opportunities for economic development, open space, and other uses.
  - » Longer paths of travel for pedestrian crossings due to the circulating nature of the roadways.

Boulevard

This alternative was initially termed a "Road Diet" option to reflect the reduced roadway cross-section, as compared to other options and the No Build. It was deliberately designed with capacity limitations to demonstrate and test the extent to which vehicular traffic would divert from the corridor. From a design perspective, the Boulevard responds to the Working Group's desire to reconnect the adjacent neighborhoods and provide greater emphasis on the McGrath corridor's local connections.

The boulevard layout narrows the roadway to three lanes in both the northbound and southbound directions on the McGrath corridor. Compared to the previous alternatives, this narrowed cross-section would reduce capacity in the corridor, which would force vehicle trips to be diverted to alternate routes or alternative modes of transportation. See Figure 4-20: Boulevard Road Diet Option. While even this alignment does not fully meet the operational capacity demands of the estimated 2035 future No-Build projected volumes, it should also be noted that many members of the Working Group and the public expressed a preference for a cross-section of two lanes in both the northbound and southbound directions to further enhance pedestrian connections and the desired local nature of the corridor. However, in order to strike a balance between the needs of the community and the continued need for regional mobility, the option of three lanes in each direction was developed for this stage in the study process.

Opportunities

- The roadway layout incorporates more traditional intersection treatments, which leads to less confusion for drivers, pedestrians, and bicyclists.
- Shorter crossings of major roads are provided, benefitting pedestrians.
- The Medford Street/Somerville Avenue intersection with the McGrath corridor can be consolidated into a single, though complex, functioning intersection.
- Maintains straightforward, high volume connection from the McGrath corridor southbound to Medford Street.
- Provides full, signalized access from Linwood Street to the McGrath corridor, improving connections for all, and creating shorter overall block sizes.
- Allows for the northbound McGrath corridor access to Somerville Avenue and Union Square.
- Traditional alignment re-knits adjacent communities, and provides evident development and frontage potential.
- Provides potential for center median planting area or linear parks along the edge of the McGrath corridor.

Figure 4-20: Boulevard Road Diet Option

Identified or Potential Issues

- Narrow, restricted alignment will likely result in vehicle trips diverting from the McGrath corridor to other neighborhood and regional roadways due to reduced roadway capacity on the McGrath corridor.
- The close proximity of the two signals on the McGrath corridor at Washington Street and at Linwood Street may result in queuing issues both northbound and southbound on the McGrath corridor.
- Northbound queues at the intersection of Washington Street with the McGrath corridor may spill back and impact operations at Linwood Street.
- Access from Poplar Street is limited and remains right-in, right-out due to the difficulties of incorporating a westbound approach through movement at the primary intersection.
- This alternative requires a complex intersection layout, signal phasing and timing at the McGrath/ Medford Street/Somerville Avenue intersection. The layout has the potential for "trapping" vehicles between the two closely spaced traffic signals which could result in added congestion between Medford Street/Somerville Avenue and the northbound McGrath corridor.
- This alternative requires prohibiting left turns from the McGrath corridor onto Washington Street, in order to minimize the roadway cross-section. This forces vehicles who wish to make a left turn to take an alternative route. For example, vehicles traveling southbound on McGrath turn at Somerville Avenue/ Poplar Street/Medford Street, travel northbound on McGrath to access Washington Street eastbound.
- This alternative favors northbound traffic access to the Brickbottom area and Washington Street, while southbound connections remain difficult.

Working Group Feedback – Focus Area

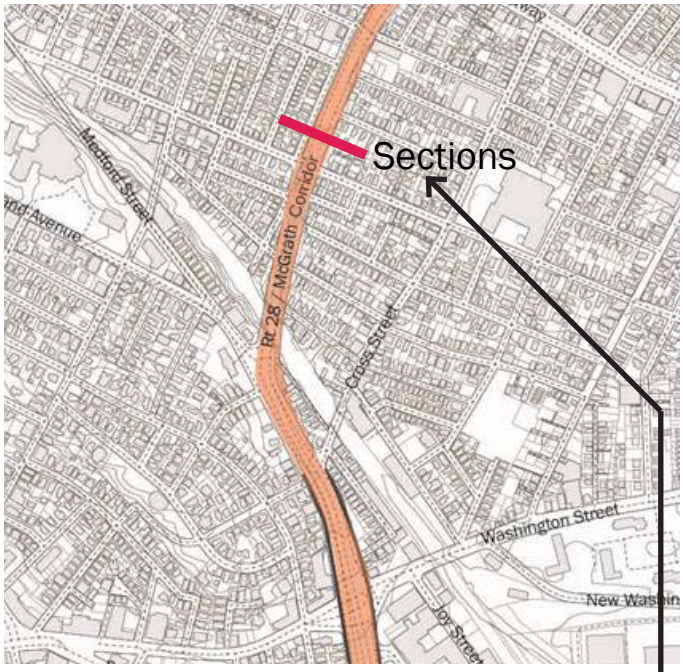
The four alternatives were presented to the Working Group, with a review of the alignment, layout, capacity, and multimodal connections. An initial assessment of how well they matched the goals and objectives adopted was also discussed. The Working Group provided the following general feedback regarding these four alternatives:

- There should be a pedestrian/bicycle connection between Brickbottom and Medford Street under the Squire's Bridge.
- The size of the rotary at Washington Street in the Signalized Rotaries Alternative is too large to support urban design goals.
- The green space within the Signalized Rotaries Alternative is difficult to access, and even though large, may not be functional or add to community benefits in a meaningful way.
- The circulating pattern of the rotaries in the Signalized Rotaries Alternative may be difficult for drivers to understand and navigate. However, these rotaries provide the advantage of full access to all cross-streets, connections that are not provided in the Median U-turns and Access Road alternatives.
- With three potential circulating lanes processing high volumes, the signalized rotary at Washington Street in the Signalized Rotaries Alternative is not pedestrian friendly.
- All scenarios should provide a direct physical and visual east/west connection along Washington Street to Union Square.
- The median U-turn and Access Road alternatives may help shift traffic from Washington Street to Somerville Avenue, improving access to Union Square and operations on Washington Street.
- Connections to Joy Street and to Allston Street should be considered for the median U-turn Alternative.
- Options that increase and improve direct east/ west pedestrian connections at major and minor intersections are supported.
- Cross-sections of intersections should be reduced when possible through reduction in the number of turn lanes.
- Connections to Poplar Street are important to the development of Brickbottom.
- The Access Road Alternative may not support retail development and ease of access to and from Union Square due to the circuitous access route from the northbound McGrath corridor, but could encourage more development in Brickbottom.
- The Boulevard Alternative received the most initial support with some members requesting analysis of further reduced vehicular capacity and cross-sections to further narrow the roadway from six lanes to four lanes.

Preliminary Concepts – North Section

The northern segment of the study area consists of the McGrath corridor north of the intersection with Medford Street/Highland Avenue. This generally includes the area between Broadway to the north, the Otis Street pedestrian bridge, intersection of Pearl Street with the McGrath corridor, Gilman Street Bridge, the Lowell Line Bridge, and the intersection of the McGrath corridor with Medford Street/Highland Avenue. This segment is already at-grade but could benefit from improvements to the cross-section in order to improve overall accessibility. MassDOT's Complete Streets policy requires balancing the use of the public right-of-way for all transportation modes.

Potential changes in the roadway cross-section in the vicinity of the Otis Street pedestrian bridge were developed to convey how the public right-of-way could be reallocated to better serve all modes of transportation



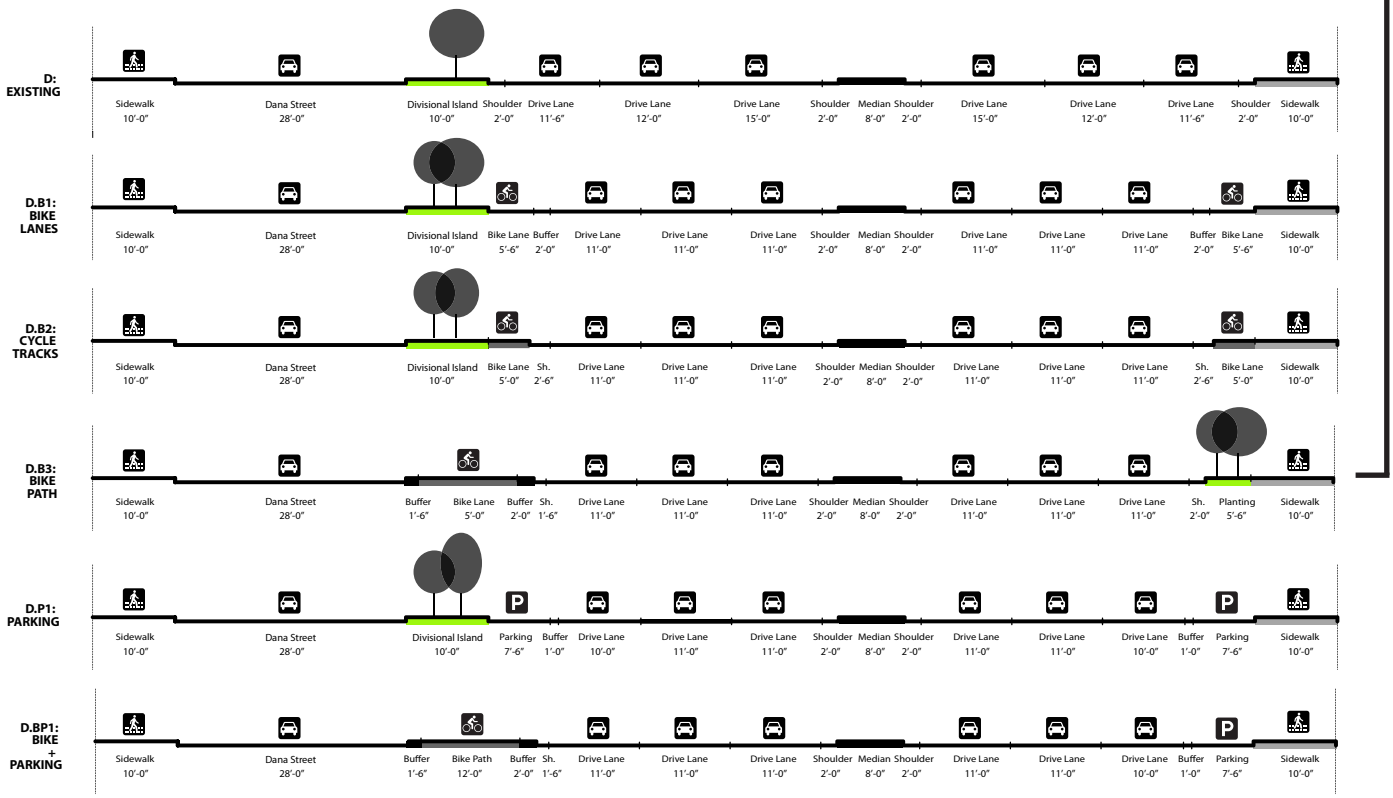


Figure 4-21: Conceptual Cross-Sections for McGrath Highway, North of Lowell Line Bridge

in the corridor and provide additional green space. The options include items such as dedicated bicycle lanes or cycle tracks, addition of on-street parking, and additional landscaped areas. The concepts are shown in Figure 4-21.

The intersection of the McGrath corridor with Medford Street/Highland Avenue is currently at-grade, and experiences delays and congestion during peak periods (see Chapter 2). One potential improvement, as presented previously in the Median U-turn Alternative for the focus area, would be the removal of the eastbound left-turn from Medford Street to the McGrath corridor northbound (see Figure 22). This option could improve traffic operations for the McGrath corridor mainline because all traffic heading northbound must stop to allow these left turns. Removing the left turns would provide more signal time to those other high-volume approaches. Removing the Medford Street left-turns onto the McGrath corridor northbound could shift more vehicles onto Pearl Street and other local streets. If so, some changes to lane configurations at the intersection of Pearl Street with the McGrath corridor and other intersections would be needed to accommodate this increased demand.

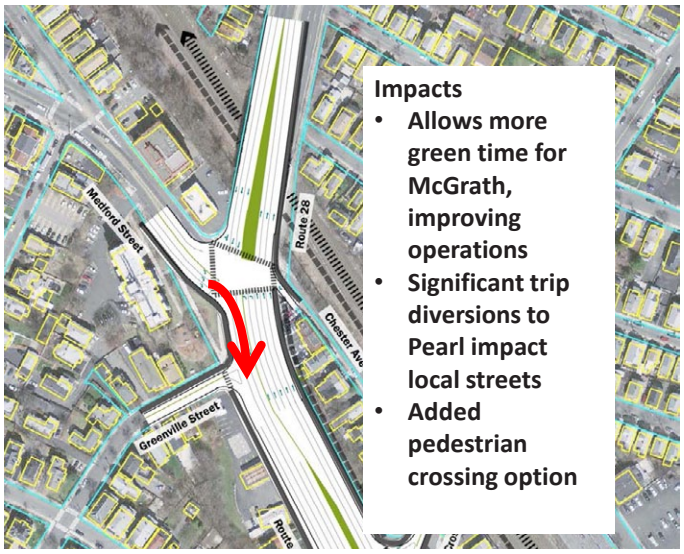


Figure 4-22: Potential Modification to Medford Street/ Highland Avenue Intersection with Route 28

Refinement of Alternatives

The Grounding McGrath Working Group was able to carry three alternatives forward to be tested through the CTPS regional travel demand model, and fully evaluated against the criteria developed. Based on the feedback from the March 7, 2012 Working Group meeting, the Boulevard option was seen as preferable and thus carried forward in a three lane alignment. The Access Road option was also brought forward because it provided additional visibility (and traffic) through Brickbottom, while also keeping the smallest mainline cross-section. Lastly, elements of both the Signalized Rotary and Median U-turn options were seen as beneficial.

The Working Group favored the traditional intersection approach at Washington Street that the Median U-turn allowed. For Somerville Avenue, the curved, wider overall right-of-way and multiple intersecting roadways lend themselves more to the rotary approach. Preliminary analysis showed that there was enough space between the two Washington Street and Somerville Avenue approaches for these elements to be combined, and thus a hybrid U-turn/rotary alternative was carried through design refinement. These three options were provided to the Boston MPO's Central Transportation Planning Staff (CTPS) for further analysis using their regional travel demand model. The results of this modeling were used by the project team to analyze the alternatives. The results of the analysis are presented in the next chapter.

CHAPTER 5: ALTERNATIVES ANALYSIS

Introduction

As the Grounding McGrath study progressed, feedback from the community and the Working Group, informed by preliminary evaluation of the conceptual alternatives, resulted in a focus on the at-grade – or "bring it down" – alternatives for the McGrath corridor. The alternatives as discussed in Chapter 4 were conceptual and informed more by planning and policy principles than engineering standards.

As the alternatives analysis advanced, the project team developed the alternatives further, to a level of detail that allowed three potential alternatives to be tested using the CTPS regional travel demand model . The following are the design alternatives, evaluated by the Grounding McGrath project team:

- Boulevard (see Figure 5-1)
- U-turn/Rotary Hybrid (see Figure 5-2)
- Linwood Access Road (see Figure 5-3)

As part of this study's coordination with the other planning efforts in the study area, a fourth alternative developed through the City of Somerville's Inner Belt/ Brickbottom Study (IBBB) was also modeled using the CTPS regional travel demand model. This alternative known as the Inner Belt/Brickbottom Alternative (see Figure 5-4) evaluated separately from the Grounding McGrath study, but the results are included (to the extent possible with available information) with the three alternatives generated through the Grounding McGrath process. This fourth alternative is similar to the Boulevard Alternative but includes a new road through the Inner Belt area, connecting Washington Street to the McGrath corridor in the NorthPoint area, as well as an extension of Poplar Street across the MBTA Lowell Line tracks from the Brickbottom neighborhood to the Inner Belt neighborhood.

Each of the four alternatives includes assumptions that the following features will be included in the physical layouts:

- Extension of the Somerville Community Path, and a shared use path within the McGrath corridor.
- Sidewalks within the focus area that are 10 feet wide.
- Pedestrian connections across the McGrath corridor as frequently as possible, to break up long block segments.
- Bicycle accommodations within the public right-of-way (ROW).
- Space within the existing right-of-way currently (and in the No Build Alternative) that is currently allocated to surface roads and ramps can be reused for other purposes, such as green space/parks or other "reclaimed" space within the ROW.

Boulevard Alternative

The Boulevard Alternative includes the following signal phasing, geometric, and infrastructure changes compared to the No Build condition:

- Removal of the McCarthy Viaduct structure from Washington Street to Medford Street.
- Reconfiguration of the Washington Street intersection with the McGrath corridor to provide three-lane approaches northbound and southbound on the McGrath corridor, and a single through lane and double left-turn lanes for the Washington Street eastbound and westbound approaches.
  - » No left turns are to be permitted from the McGrath corridor northbound or southbound approaches onto Washington Street. Vehicles that previously made these left-turns will be able to access Washington Street via tturns at other intersections: vehicles destined for Union Square traveling from the south will be able to turn left onto Somerville Avenue, and vehicles from the north destined for Sullivan Square will be able to turn left onto Poplar Street and travel north to their destination along Washington Street.
- Reconfiguration of the intersections of Somerville Avenue and Medford Street, and the McGrath corridor and Poplar Street into two adjacent signalized intersections under a single controller. A short roadway with a three-lane cross-section connects the two signals, providing a westbound through/right-turn lane, an eastbound left-turn lane and an eastbound shared through/right-turn lane. The eastern intersection will provide three through lanes with a dedicated left turn lane for both the southbound and northbound directions on the McGrath corridor.
- Realignment of Poplar Street to meet the McGrath corridor at the reconfigured intersection with Medford Street and Somerville Avenue. Poplar Street has

Figure 5-1: Boulevard Alternative

SECTION
A-A

Figure 5-2 : U-Turn/Rotary Hybrid Alternative

SECTION A-A

Figure 5-3 : Linwood Access Road Alternative

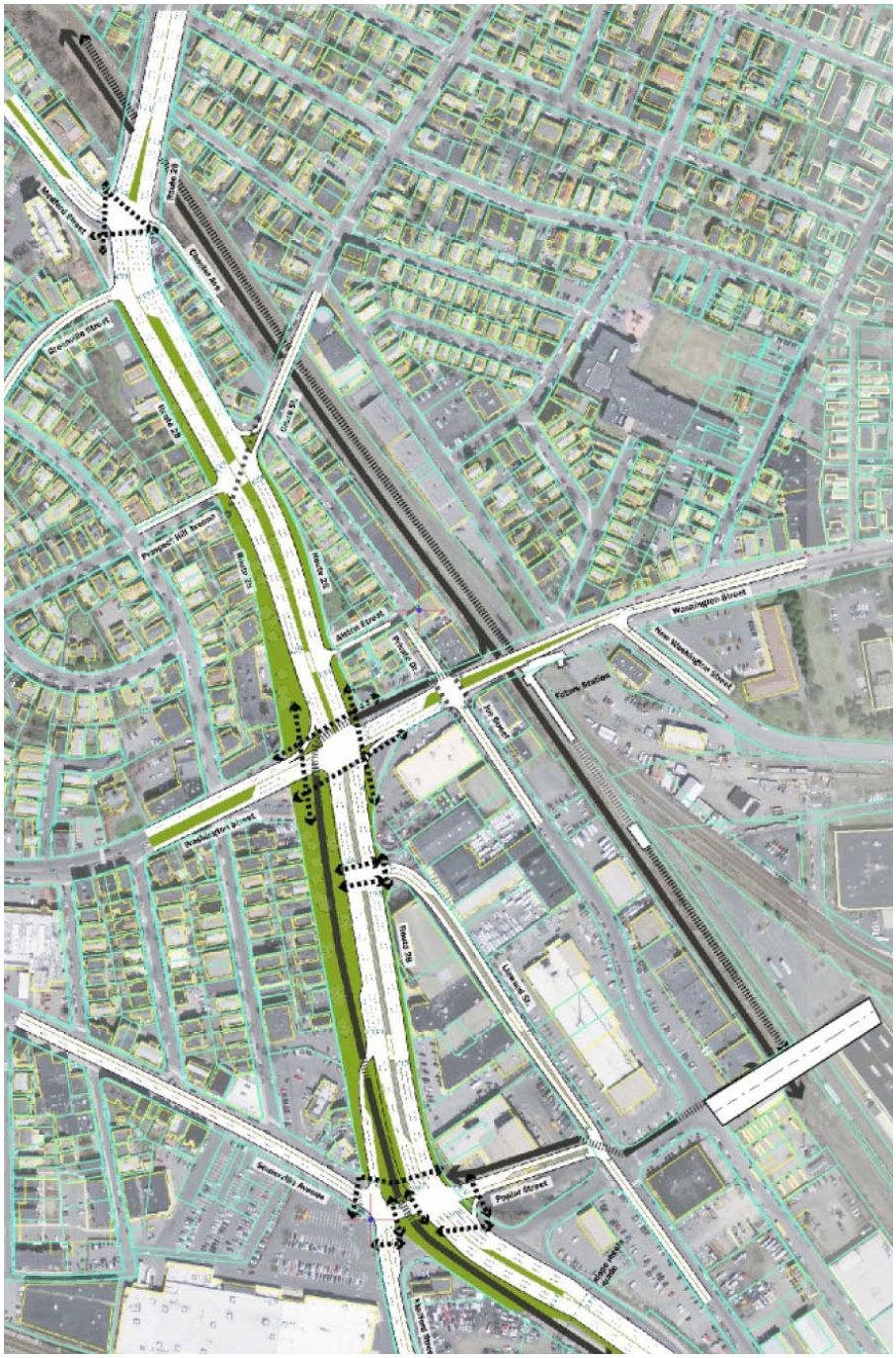


Figure 5-4 : IBBB Alternative

Figure 5-5: Key Elements of Circulation for Boulevard Alternative

one lane eastbound and one lane westbound. A dedicated southbound left turn lane is provided from the McGrath corridor to Poplar Street. Somerville Avenue is one lane westbound, and two lanes eastbound, with a single through lane, and a shared through/right-turn lane at the intersection approach.

- Reconfiguration of the signalized intersection at Linwood Street and the McGrath corridor providing three northbound lanes, three southbound lanes, and a westbound lane from Linwood Street. A signalized pedestrian crossing is provided. No left turns are permitted from the McGrath corridor southbound onto Linwood Street.
- New signalized intersection at Cross Street and Prospect Hill Avenue at the McGrath corridor providing a signalized pedestrian crossing. No left turns are permitted from the McGrath corridor northbound or southbound.
- Stop-controlled intersection at Greenville Street with two left-turn lanes from the McGrath corridor northbound.
- Realignment of Chester Avenue into the intersection of the McGrath corridor with Medford Street.

Figure 5-5 illustrates the key elements of circulation for the Boulevard Alternative.

U-turn/Rotary Hybrid Alternative

The U-turn/Rotary Hybrid Alternative includes the following signal phasing, geometric, and infrastructural changes compared to the No Build condition:

- Removal of the McCarthy Viaduct structure from Washington Street to Medford Street.
- Reconstruction of the McGrath corridor intersection with Poplar Street, Somerville Avenue and Medford Street into a single signalized rotary. All turning movements will be made from the rotary, while through movements on the McGrath corridor mainline will pass through the middle of the rotary. All vehicular access between the side streets and the McGrath corridor will be provided via the circulation road. The circulation road is signalized at its intersections with the McGrath corridor at the northern and southern areas of the rotary.
- Realignment of Poplar Street and Medford Street to include a single lane approach to the circulation road, each under yield control. Somerville Avenue is to be realigned to include a two lane, unsignalized eastbound approach to the circulation road. Vehicles traveling along the circulation road will also be able to gain access to Poplar Street, Medford Street and Somerville Avenue via right-turn lanes departing the roadway.
- Reconstruction of the intersection of the McGrath corridor and Washington Street, eliminating all left-turn movements at the intersection. The eastbound and westbound Washington Street approaches will include two through lanes and two exclusive right-turn lanes while the northbound and southbound McGrath corridor approaches will include three through lanes and a single exclusive right-turn lane. All left-turns at the McGrath corridor and Washington Street intersection are processed via new signalized U-turn intersections located north and south of Washington Street. Vehicles wishing to turn left would travel through the intersection to the new U-turn intersections, complete a U-turn and travel back to the intersection of the McGrath corridor and Washington Street, to turn right and continue on the intended path of travel.
- The eastbound left-turn from Highland Avenue/ Medford Street onto the McGrath corridor northbound is to be eliminated in this alternative. All traffic would be directed to travel southbound on the McGrath corridor. Any vehicles from Highland Avenue/Medford Street destined to travel northbound on the McGrath corridor must do so via a signalized U-turn at the northern U-turn intersection located between Medford Street and Washington Street.
- Two-phase traffic signals are required at the Somerville Avenue rotary and Washington Street intersections with the McGrath corridor.
- This alternative requires a wider right-of-way at Washington and Somerville Avenue, which includes potential impacts to private property.

Figures 5-6 through 5-10 illustrate the circulation for the U-turn/Rotary Hybrid Alternative.

Linwood Access Road

The Linwood Access Road Alternative includes the following signal phasing, geometric, and infrastructural changes compared to the No Build condition:

Figure 5-6: Circulation to Union Square for U-turn/Rotary Alternative

Figure 5-7 : Circulation from Union Square for U-turn/ Rotary Alternative

Figure 5-8: Southbound U-turn Circulation for U-turn/ Rotary Alternative

Figure 5-9: Northbound U-turn Circulation for U-turn/ Rotary Alternative

Figure 5-10: Circulation from Highland Avenue for U-turn/ Rotary Alternative

- Removal of the McCarthy Viaduct structure from Washington Street to Medford Street.
- Conversion of Linwood Road into a northbound access road and the construction of a southbound access road parallel to the McGrath corridor. The path of the northbound access road (one lane) follows the existing Linwood Street alignment through the Brickbottom District, and the southbound access road (two lanes) is located along the McGrath corridor mainline.
- The access road would allow for one-way circulation and provide access between the McGrath corridor and the intersecting side streets (Washington Street, Poplar Street, Somerville Avenue and Medford Street). The access road would be signalized at its northern and southern intersections with the McGrath corridor, where all the turning movements would occur.
- The Linwood Access Road would provide access to/from Poplar Street, Washington Street, Somerville Avenue and Medford Street via two-lane, yield control approaches (with the exception of Poplar Street which is a single lane approach). Vehicles traveling towards the McGrath corridor on any of these roadways would travel onto the access road and continue to the next signalized intersection to complete the necessary movement to continue on their intended path.
- The McGrath corridor mainline is proposed to contain two travel lanes in both the northbound and southbound directions through the access road area, with an additional travel lane to be located at each of the signalized access road intersections.
- The new signalized intersections of the northern and southern access roads with the McGrath corridor are proposed to include two phase traffic signals. The eastbound access road approach at the southern access road intersection provides two exclusive left-turn lanes and a shared through/right-turn lane. The westbound access road approach at the northern access road intersection provides a single left-turn lane, through-lane and right-turn lane. The signals at each of these locations provide a phase for the northbound and southbound McGrath corridor approaches and then a phase for the access road approaches, which circulating vehicles can use to make their appropriate desired turning movements.

Figures 5-11 through 5-14 illustrate circulation for the Linwood Access Road Alternative.

Evaluation Criteria

Evaluation criteria were developed to measure how each alternative, including the No Build Alternative, accomplishes the goals and objectives of the Grounding McGrath study (see Table 5-1). The criteria were structured to provide both qualitative and quantitative measures to rank each alternative. The criteria are not intended to be an absolute measure, rather they are meant to provide insight into how the McGrath alternatives compare and relate to one another. The goals, and therefore major categories in the Evaluation Matrix, include:

Goal 1. Improve access and mobility: Move people efficiently by all modes along and across the corridor on all local and regional desire lines

- **1.1. Improve regional and local travel time**
- **1.2. Improve health of residents**
- **1.3. Facilitate multimodal transportation opportunities**

Goal 2. Promote connectivity: Improve the cohesion of abutting neighborhoods for the sake of community, placemaking and economic development

- **2.1. Identify opportunities for new connections**
- **2.2. Improve urban form/places**
- **2.3. Improve access to open space**
- **2.4. Support and/or generate economic development**

Goal 3. Improve and balance functionality: Ensure cost-effective and efficient use of many modes

- **3.1. Enhance safety for all modes**
- **3.2. Maintain regional travel capacity**
- **3.3. Limit impacts on surrounding roadways**
- **3.4. Ensure cost efficiency of long-term corridor maintenance**

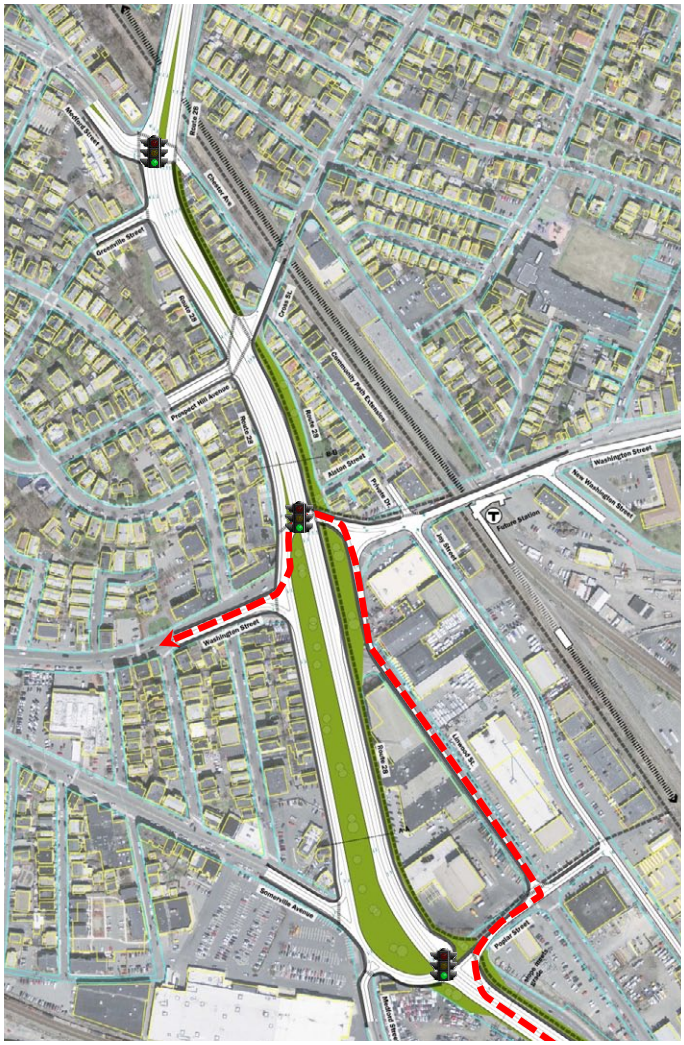


Figure 5-11: Circulation to Union Square for Linwood Access Road Alternative

Figure 5-12: Circulation from Union Square for Linwood Access Road Alternative

Figure 5-13: Washington Street Westbound Through Circulation for Linwood Access Road Alternative

Figure 5-14: Washington Street Westbound Left Circulation for Linwood Access Road Alternative

Goal 4. Provide accountability: Advance a design that is sensitive to the needs and desires of stakeholders

4.1. Strong public input and responsiveness to local concerns

4.2. Demonstrate consistency with local and regional plans

4.3. Share benefits and burdens of changes

4.4. Limit impact to environment

Quantitative Evaluation Criteria

The project team, working with the community and Working Group, developed quantifiable measures for most of the Objectives. Measures were derived from the technical information developed for all scenarios from the following major primary sources:

- The CTPS regional travel demand model
- Micro-simulation Transportation Analysis using Synchro software
- Geographic Information System (GIS) based analysis

In some cases, information from multiple primary sources is combined to best provide a measure of the desired objective. For each objective, the raw value of each measure was included in the Matrix for each scenario. All were compared to the 2035 No Build, with the change in each alternative further identified.

Column Headings

The columns in the Evaluation Matrix provide a summarized description of how each of the objectives was measured and the results of those measurements, as well as how each alternative compares to the 2035 No Build. A further description of each Column is provided below:

Evaluation Criteria

No.: - A numbering convention showing the Goal (1), Sub Goal (1.1) and Objective (1.1.1)
Goals and Objectives: The Goals, Sub Goals and Objectives outlined by the Grounding McGrath project. These are meant to capture impacts to various user groups and desires of the Study.
Description: A description of the factor that will be measured to evaluate the objective.
Criteria: The more specific metric used to quantitatively (to the extent possible) ascertain the impact of the alternative relative to the Objective.
Geography: The study area used for a given criteria. Note that this metric varies based on the criterion, ranging from those focused immediately on the corridor, to those that are regionally based. Many of the objectives in the Study are intended to explain and clarify the balance and tradeoffs between regional and local demands.
Inputs: The specific dataset used to provide quantifiable information. Many of these are culled from larger datasets (CTPS Regional Model, Micro Simulation, Concept Design), or developed specifically as described. Further information and more detail on each are available in the appendices.
Methodology/Details: The calculation applied to the dataset used as an Input, or the description thereof.
2035 No Build: The No Build future year was developed using the adopted 2035 land use and transportation network from the Boston Region MPO's Regional Transportation Plan.

Alternatives Evaluation

This section of the Matrix shows how each of the four alternatives performed on the Evaluation Criteria and how they compared to the 2035 No Build. Note that the evaluation of the Inner Belt Alternative was developed by the City of Somerville through the Inner Belt/Brickbottom Study.

Ranking: A qualitative type of analysis showing the relative difference between the alternatives and the No Build, effectively showing the range (Worse, Slightly Worse, the Same, Slightly Better, Better) for each objective as compared to the No Build.
Value: The actual numerical value derived through the evaluation process for each objective. The 2035 No Build is considered the baseline value.
Change: The difference between the value for an alternative and the baseline 2035 No Build alternative.

Descriptions

As described above, the Evaluation Matrix outlines the objectives and provides a shorthand description of the various criteria developed to best capture the goals and values of the project as a whole. These indicators provide both qualitative and quantitative measures to rank each of the scenarios, and are described further below. In many cases, the complete data sets (i.e., Synchro reports detailing intersection level of service) and further information on each criteria and data source (i.e., CTPS outputs from the regional travel demand model) are available in the appendices of this report.

1. IMPROVE ACCESS AND MOBILITY – MOVE PEOPLE EFFICIENTLY BY ALL MODES ALONG AND ACROSS THE CORRIDOR ON ALL LOCAL AND REGIONAL DESIRE LINES.

1.1. Improve local and regional travel time

1.1.1. Balance of regional and local access needs- Uses the CTPS model to determine the percentage of peak hour auto trips within the study area neighborhoods that are local versus regional. Better local connections for all modes, coupled with greater auto delay, are likely to reduce the number of auto trips.

1.1.2. Access to and around corridor- Counts the number of intersection approaches along the McGrath corridor. New connections provide additional opportunities for corridor and neighborhood access.

1.1.3. Travel time - Measures average travel time for auto and transit trips (using the CTPS model) for local and regional trips originating or ending in the study area neighborhoods, compared to trips originating or ending in the MPO region as whole. The aggregate number in the matrix shows the ratio of travel time for local trips to travel time for regional trips.

1.2. Improve health of residents

1.2.1. Comprehensiveness of pedestrian and cycling network – The study team identified "desire lines" (described in Chapter 2 – Existing Conditions) as commonly used paths between important destinations in the study area. Paths were ranked based on their pedestrian and bicycle facilities using the following points system: Sidewalks – 1, Bike lanes – 1, Sharrows – 0.5.

1.2.2. Ability to change mode share – Looks at the degree to which walking and/or biking facilities meet a primary desire line in the study area between Broadway and the Twin City Mall. 1.2.2 uses the same scoring system as 1.2.1.

1.2.3. Sidewalk connectivity – Compares average block length for each alternative as a measure of the density and coverage of the sidewalk network in the study area. Shorter block lengths and a more connected sidewalk network mean that pedestrians have more direct access – shorter walks – to locations around and across the corridor.

1.2.4. Environmental data metrics – Using CTPS model output, compares environmental pollutant amounts for all alternatives. These pollutants include Particulate Matter up to 10 micrometers in size(PM10), carbon dioxide (CO2) emission in winter, mono-nitrogen oxides NO and NO2(NOx), volatile organic compounds (VOC), and Particulate Matter up to 2.5 micrometers in size(PM 2.5).

1.3. Facilitate multimodal transportation opportunities

1.3.1. Assessment of all modes – Using a more focused study area and CTPS model outputs, compares mode splits for all alternatives.

1.3.2. Impacts on all vehicular travelers – Uses CTPS model outputs that specifically focus on traffic volumes at the "gateways" to the study area. The "gateways" relate to the trip link analysis where vehicles enter the study area. This measure is intended to analyze the effect that changes to vehicular capacity along the McGrath corridor will have on the regional flow of vehicular traffic entering and exiting the study area, and uses the 3-hour PM peak volumes.

2. PROMOTE CONNECTIVITY – IMPROVE THE COHESION OF ABUTTING NEIGHBORHOODS FOR THE SAKE OF COMMUNITY, PLACEMAKING, AND ECONOMIC DEVELOPMENT.

2.1. Identify new connections

2.1.1. Multimodal connections – The number of sidewalks that cross the corridor. This metric analyzes new links between the neighborhoods and

facilities on the east and west side of the McGrath corridor.

2.2. Improving urban form/ places

2.2.1. Impacts of traffic, congestion, or character on/to adjacent districts – A ratio of Synchro queue lengths to the CTPS modeled vehicle speeds on select neighborhood paths, i.e. (average queue length/average vehicle speeds) for each scenario. Longer queue lengths at intersections and lower speeds on paths mean that traffic will generally be slower and the corresponding ratio higher. These conditions can help foster a more lively and inviting pedestrian and bicycle environment in neighborhoods in the study area.

2.2.2. Buffers between travel lanes and communities – Calculates a ratio of sidewalk, parking, median or other non-travel lane width to that of travel lanes for McGrath highway. A higher number indicates that the buffer between vehicles travelling on the McGrath corridor and surrounding neighborhoods is greater.

2.2.3. Appropriate scale, massing, and form for new development – Assumes that a lot size of 20,000 square feet is the minimum for development with the capacity for multiple uses, and calculates the number of areas created that could be used for such development in each alternative.

2.2.4. View corridors and incorporation into placemaking – Streets provide an important visual connection between neighborhoods. This metric counts streets that provide that link by crossing McGrath at-grade.

2.3. Improve access to open space

2.3.1. Acreage of open space – Analyzes the amount of new open space that the alternatives would provide in neighborhoods that abut McGrath.

2.3.2. Sidewalk space – Uses Computer-Aided Design (CAD) and Google Earth analyses to determine the acreage of sidewalk space in the corridor study area.

2.3.3. Pedestrian connections to open space – Measures the average pedestrian distance from major intersections in the corridor to open space in the corridor study area.

2.3.4. Roadway width crossing – Analyzes the change in the average width of travel lanes that pedestrians must traverse to get across McGrath. Longer widths can be physical and/or mental barriers to access.

2.4. Support and/ or generate economic development – Long term economic implications

2.4.1. Real estate: Vacancy rates, property values, lease rates – Uses qualitative metrics such as street width and retail street frontage to rank the alternatives based on potential real estate values.

2.4.2. Economic Activity: Employment sales, revenues– Uses qualitative metrics such as street width and retail street frontage to rank the alternatives based on potential economic activity.

2.4.3. Financial Impact: Transportation Access – Portions of McGrath that will add on-street parking are assumed to be those that will provide access to retail outlets. Thus, this metric looks at the volume of traffic in those areas as a proxy for access to local markets.

2.4.4. Financial Impact: User Cost – The Texas Transportation Institute's (TTI) Annual Urban Mobility Report estimates hours lost per year due to congestion in the Boston Area at 117,234,000. The report calculates the financial cost of those hours to be $2,393,000,000 using person hours and excess fuel consumed. This estimate can thus be converted to cost per second of delay, which works out to $0.006 in the Boston metropolitan area. This Financial Impact measurement uses Synchro aggregate AM and PM peak delay outputs for intersections in the McGrath corridor study area multiplied by TTI delay costs/seconds of delay to estimate the cost of congestion for each alternative.

3. IMPROVE AND BALANCE FUNCTIONALITY – ENSURE COST EFFECTIVE AND EFFICIENT USE OF MANY MODES

3.1. Enhance safety for all modes

3.1.1. Vehicle Speeds – This metric compares CTPS model output of AM and PM peak period speeds for each alternative in the study area neighborhoods.

3.1.2. Vehicle speeds at "gateway" links – The study team identified common vehicular paths and

used CTPS to model travel speeds as well as times on those paths. This provides an insight focused on roads around the McGrath corridor, rather than the corridor itself.

3.2. Maintain regional travel capacity

3.2.1. Travel time delay at key intersections and links – Uses Synchro outputs for intersections on the McGrath corridor and the aggregate time devoted to pedestrians in cycle timing as compared to overall signal cycle time. This provides some insight into delay due to signals rather than traffic volumes.

3.2.2. Enhance mobility by making corridor operations more predictable – Compares queue length and intersection capacity utilization using Synchro outputs for the corridor. These indicators not only describe potential delay in the corridor, they also provide insight into the potential operations at each intersection.

3.3. Impacts on surrounding roadways

3.3.1. Functional capacity of neighborhood roadways – Uses CTPS travel demand outputs to compare vehicular volume on streets that cross the corridor.

3.3.2. New or improved connections – Uses CTPS travel demand outputs to compare vehicular volumes on the McGrath corridor and the streets that cross it.

3.3.3. Parking and loading access – Compares the length of McGrath corridor segments with parking for each alternative. This metric is a way to analyze beginning and end of trip vehicle capacity.

4. PROVIDE ACCOUNTABILITY – ADVANCE A DESIGN THAT IS SENSITIVE TO THE NEEDS AND DESIRES OF STAKEHOLDERS

4.1. Share benefits and burdens of changes

4.1.1. Vehicle hours traveled in the region – Compares CTPS travel demand model outputs of the vehicle hours travelled (VHT) in each focus area neighborhood to ensure that benefits and burdens of changes are shared.

4.1.2. Impacts on Environmental Justice populations – Compares CTPS travel demand model outputs of VHT in each focus area neighborhood and the percentage of each neighborhood that qualifies as Environmental Justice populations to analyze EJ populations affected by vehicles traveling through the study area.

4.2. Limit impact to environment

4.2.1. Air quality/carbon footprint (Vehicle Miles Traveled (VMT) and Greenhouse Gases (GhG)) – Compares the CTPS summary of CO2 emission results for each alternative.

4.2.2. Stormwater impacts (flooding and runoff) – Compares the square footage of green space in the corridor to calculate the amount of pervious surface each alternative will add.

4.2.3. Other environmental resources to be impacted – A count of removed trees, new trees, and green space acreage for each alternative. Count partially generated using an assumed 20 Elm and/or Plum trees per acre of green space in the Boston area.

4.3. Ensure long-term corridor maintainability

4.3.1. Feasible maintenance plan for corridor– Ensure a sustainable maintenance program. Compares the average annual maintenance costs per mile versus the MassDOT urban roadway average.

4.3.2. Fiscal impacts of alternatives – Compares MassDOT, market and census data to cacluate a return on investment calculation.

4.3.3. Cost to construct – Uses several assumptions, detailed in the cost analysis section of this chapter to calculate life cycle cost estimates for maintaining McGrath as well as the alternatives.

Evaluation by Topic Area

The Evaluation Matrix in Table 5-1 and described previously, is based on the goals and objectives of the study. This section describes some of the specific analysis elements that served as the inputs to the matrix.

Mobility Analysis

Mobility relates to the highway, transit, bicycle and pedestrian systems. Three of the four major goals for the Grounding McGrath study address mobility to some

degree, and are therefore included in the Evaluation Matrix.

Vehicles

As noted previously, estimating the changes in vehicle travel patterns that are the basis for the mobility analysis require consideration of the physical changes included in each of the alternatives, the CTPS travel demand model, and micro-simulation analysis. This section describes how the CTPS model results were coordinated with micro-simulation for vehicular traffic flow, and the resulting outputs that were then considered in the Evaluation Matrix.

The Grounding McGrath project team worked in close collaboration with CTPS to evaluate the alternatives in the context of the regional model. The approaches were coordinated and the team received concurrence from CTPS as each step of the process proceeded.

Estimating the changes in vehicle travel patterns started with an initial capacity analysis using Synchro 7.0 software for the 2035 No Build scenario and for the 2035 potential Build scenarios developed through the Alternatives Development process (see Chapter 4):

- Boulevard
- U-Turn/Rotary Hybrid
- Linwood Access Road

Initial Synchro networks depicting the three future build alternatives were provided to CTPS to use as the basis for the regional model runs. Each alternative assumed the 2035 No Build volumes generated by CTPS, and no changes were made to trip distributions prior to submittal to CTPS.

The preliminary Synchro models were then transferred to CTPS to advise them on the lane configurations and resulting capacity proposed under each of the potential Build scenarios. The CTPS regional travel demand model was then able to estimate the traffic volumes on selected roadway links for each alternative based on the changes in intersection and roadway capacity, the expected congested speeds and the presence of additional links created via new connections proposed in the alternatives. The general methodology used to convert the CTPS link volumes to intersection turning movements is provided in Appendix H of this report. It is important to note that the CTPS analysis is based on a 3-hour peak period, while the Synchro analysis is based on 1-hour peak periods. Conversion rates of 0.4 in the AM and 0.36 in the PM were used to convert the CTPS outputs from a 3-hour peak period to an equivalent 1-hour peak for the capacity analysis in Synchro.

The summary table of traffic volumes produced through the CTPS regional model is included in Appendix I. The intersection capacity analysis summaries are included for each alternative with more detailed summaries of vehicular Level of Service (LOS), queue lengths and delay provided in Appendix E. The CTPS regional travel demand model is a tool to analyze regional traffic and is not intended for micro-analysis. The model is based on link capacity and speed, while the Synchro capacity analysis is based upon the turning movements at a specific intersection.

With the implementation of reduced capacity and the speed changes due to potential congestion for the modeled alternatives, the CTPS regional travel demand model indicated a significant reduction in volumes along the McGrath corridor. As a result of this reduction in traffic volumes, the implementation of a narrower north/south cross section may be feasible. However, it should be noted that this feasibility is based on the assumption that a number of vehicles which currently travel along the McGrath corridor will not do so in the future, and the potential impact of those diverted trips should be considered by the impacted communities. Additionally, vehicular movements that are currently grade separated with free-flow movement will be difficult to process at the new at-grade signals along the corridor, due to the resulting turning movements and corresponding delay. All three of the future Build alternatives have the following issues and challenges in common:

- Some traffic volume is diverted from the McGrath corridor to other roadways in the region. The trip diversions predicted by the CTPS regional travel

No.	Goal & Objective	Description	Criteria	Geography	Inputs	Methodology/Details
			WORSE / SAME / BETTER		Compared to 2035 No Build	
1	**IMPROVE ACCESS AND MOBILITY**		To move people efficiently by all modes along and across the corridor on all local and regional desire line			
1.1	**Improve regional and local travel time**					
1.1.1	*Balance of regional and local access needs*	Share of auto trips attributed to regional and local purposes.	Change in share of regional versus local auto trips	Study Area Neighborhoods: Central Davis E. Cambridge E. Medford E. Somerville Fresh Pond Harvard Inner Belt/Brickbottom Kendall/MIT Medford Hillside North Cambrdige North Medford South Medford Spring Hill Union Square West Medford/Medford Square Winter Hill	CTPS Model Output: Subarea Traffic Summary	Ratio of aggregate AM & PM local trips to regional trips. For non-auto trips, see 1.3
1.1.2	*Access to and around corridor*	Preserve opportunities to access the corridor and move within it	Change in number of intersection valences	Corridor Study Area - "Corridor Map"	Valences (Intersection Approaches -- see Corridor Map tab)	All intersecting roadways are assumed to be multi-modal. No dedicated non-motorized connections are considered for this measure.
1.1.3	*Travel time*	Travel times for all modes for regional v. local origin-destinations pairs served by the corridor	Proportional change in travel time by destination (regional v. local)	Study Area Neighborhoods: Central Davis E. Cambridge E. Medford E. Somerville Fresh Pond Harvard Inner Belt/Brickbottom Kendall/MIT Medford Hillside North Cambrdige North Medford South Medford Spring Hill Union Square West Medford/Medford Square Winter Hill	CTPS Model Output: Average Travel Time for Trips Leaving from and Arriving at Selected Neighborhoods by Auto and by Transit	Ratio of aggregate AM & PM local AUTO trip times to regional trips. Ratio of aggregate AM & PM local TRANSIT trip times to regional trips.
1.2	**Improve health of residents**					
1.2.1	*Comprehensiveness of pedestrian and cycling network*	Accommodate walking and biking facilities along all desire lines	Degree to which dedicated walking or biking facilities meet identified desire lines.	Corridor Study Area - "Corridor Map"	Sidewalks: 1 Bike lanes: 1 Sharrows: 0.5	Each "link" (intersection to intersection) in the study area analyzed by whether it has sidewalks, bike lanes, or sharrows. Desire lines identified as paths between activity centers in the corridor study area.
1.2.2	*Ability to change mode share*	Presence of alternative modal connections to accommodate a mode choice shift	Degree to which dedicated walking or biking facilities meet primary desire line	Corridor Study Area - "Corridor Map"	Sidewalks: 1 Bike lanes: 1 Sharrows: 0.5	Uses Broadway-Twin City Mall O-D pair as proxy for others.
1.2.3	*Sidewalk connectivity*	Ability for existing cross-corridor sidewalks to connect	Average block length in corridor (ft)	Corridor Study Area - "Corridor Map"	Block length in corridor area	

2035 No Build	Boulevard			Access Road			Hybrid U-Turn/Rotary			Boulevard & Inner Belt Rd		
Value	Ranking	Value	Change	Ranking	Value	Change	Ranking	Value	Change	Ranking	Value	Change
S												
0.3778	◑	0.3781	0.0003	◑	0.3780	-0.0002	◑	0.3782	-0.0004	◑	0.3780	0.0001
69	◑	69	0	◑	73	4	●	77	8	◑	69	0
1.0627	◑	1.0605	-0.0021	◑	1.0633	0.0006	◑	1.0619	-0.0008	◑	1.0605	-0.0021
0.9405	◑	0.9422	0.0017	◑	0.9417	0.0012	◑	0.9410	0.0005	◑	0.9423	0.0018
60	●	101	41	●	101	41	●	101	41	●	101	41
11	●	26	15	◕	26	13	◕	26	13	●	26	15
504.52 ft	◕	496.73 ft	-7.79 ft	◔	516.42	11.90 ft	●	477.63 ft	-26.89 ft	◕	496.73 ft	-7.79 ft

No.	Goal & Objective	Description	Criteria	Geography	Inputs	Methodology/Details
			WORSE ◔ ◑ SAME ◕ BETTER ●		Compared to 2035 No Build	
1.2.4	*Environmental data metrics*	Neighborhood pollutants	Summary of air quality measures in study area.	Study Area Neighborhoods: Central Davis E. Cambridge E. Medford E. Somerville Fresh Pond Harvard Inner Belt/Brickbottom Kendall/MIT Medford Hillside North Cambrdige North Medford South Medford Spring Hill Union Square West Medford/Medford Square Winter Hill	CTPS Model Output: Summary of Air Quality Results. Sum of AM&PM Peak 3-hour time period results.	PM10 CO Emission (in winter) NO_x Comparison VOC Comparison CO2 PM2.5 Noise
1.3	**Facilitate multimodal transportation opportunities**					
1.3.1	*Assessment of all modes*	Create multi-modal options in corridor.	Comparison of corridor mode shares for alternatives. Extent of study area defined specifically for this analysis.	Aggregate of neighborhoods listed below	CTPS Model Output: Mode Split AM & PM Peak Period	Auto Transit Walk/Bike
				Inner Belt/Brick Bottom		Auto Transit Walk/Bike
				East Cambridge		Auto Transit Walk/Bike
				East Somerville		Auto Transit Walk/Bike
				Kendall/MIT		Auto Transit Walk/Bike
				Spring Hill		Auto Transit Walk/Bike
				Union Square		Auto Transit Walk/Bike
				Winter Hill		Auto Transit Walk/Bike
1.3.2	*Impacts on all vehicular travelers*	Assess change in vehicle trips in study area relative to local and regional need.	Measure of vehicle trips displaced to other roads within study area.	Study Area Neighborhoods: Central Davis E. Cambridge E. Medford E. Somerville Fresh Pond Harvard Inner Belt/Brickbottom Kendall/MIT Medford Hillside North Cambrdige North Medford South Medford Spring Hill Union Square West Medford/Medford Square Winter Hill	CTPS Model Output: Changes of Link Volume at Gates of Select Area [PM]	Aggregate vehicle trips at "gates" of study area at PM peak three hours.

2035 No Build	Boulevard			Access Road			Hybrid U-Turn/Rotary			Boulevard & Inner Belt Rd		
Value	Ranking	Value	Change	Ranking	Value	Change	Ranking	Value	Change	Ranking	Value	Change
33.2 kg		32.9 kg	-0.3 kg		33 kg	0 kg		33.0 kg	-0.2 kg		33 kg	0 kg
10718 kg		10661 kg	-57 kg		10674 kg	-44 kg		10671 kg	-47 kg		10660 kg	-58 kg
203 kg		201 kg	-2 kg		203 kg	0 kg		201 kg	-2 kg		201 kg	-2 kg
268 kg		267 kg	-1 kg		268 kg	0 kg		267 kg	-1 kg		267 kg	-1 kg
See 4.4.1												
15.2 kg		15.0 kg	-0.2 kg		15 kg	0 kg		15.0 kg	-0.2 kg		15 kg	0 kg
44.5%		44.5%	0.0%		44.5%	0.0%		44.5%	0.0%		44.5%	0.0%
23.8%		23.8%	0.0%		23.8%	0.0%		23.8%	0.0%		23.8%	0.0%
31.8%		31.8%	0.0%		31.8%	0.0%		31.8%	0.0%		31.8%	0.0%
55.3%		55.3%	0.0%		55.3%	0.0%		55.3%	0.0%		55.3%	0.0%
19.8%		19.8%	0.0%		19.8%	0.0%		19.8%	0.0%		19.8%	0.0%
24.8%		24.8%	0.0%		25.0%	0.3%		24.8%	0.0%		24.8%	0.0%
27.3%		27.5%	0.3%		27.3%	0.0%		27.3%	0.0%		27.3%	0.0%
29.8%		29.8%	0.0%		29.8%	0.0%		29.8%	0.0%		29.8%	0.0%
42.8%		42.8%	0.0%		43.0%	0.2%		42.8%	0.0%		42.8%	0.0%
52.8%		52.8%	0.0%		52.8%	0.0%		52.8%	0.0%		52.8%	0.0%
26.5%		26.5%	0.0%		26.5%	0.0%		26.8%	0.3%		26.5%	0.0%
20.8%		20.8%	0.0%		20.8%	0.0%		20.8%	0.0%		20.8%	0.0%
29.5%		29.5%	0.0%		29.5%	0.0%		29.5%	0.0%		29.5%	0.0%
27.5%		27.5%	0.0%		27.5%	0.0%		27.5%	0.0%		27.5%	0.0%
43.0%		43.0%	0.0%		43.0%	0.0%		43.0%	0.0%		43.0%	0.0%
53.8%		53.8%	0.0%		53.8%	0.0%		53.8%	0.0%		53.8%	0.0%
19.0%		19.0%	0.0%		19.0%	0.0%		19.0%	0.0%		19.0%	0.0%
27.8%		27.8%	0.0%		27.8%	0.0%		27.8%	0.0%		27.8%	0.0%
46.5%		46.5%	0.0%		46.8%	0.2%		46.5%	0.0%		46.5%	0.0%
20.8%		20.8%	0.0%		20.8%	0.0%		20.8%	0.0%		20.8%	0.0%
32.8%		32.8%	0.0%		33.3%	0.5%		32.8%	0.0%		32.8%	0.0%
53.8%		53.8%	0.0%		53.8%	0.0%		53.8%	0.0%		53.8%	0.0%
17.3%		17.3%	0.0%		17.3%	0.0%		17.5%	0.3%		17.3%	0.0%
29.0%		29.0%	0.0%		29.3%	0.3%		29.3%	0.3%		29.0%	0.0%
165,628		166,212	584		165,731	103		166,023	395		166,115	487

No.	Goal & Objective	Description	Criteria	Geography	Inputs	Methodology/Details
					Compared to 2035 No Build	
2	**PROMOTE CONNECTIVITY**		To improve the cohesion of abutting neighborhoods for the sake of community, placemaking, and economic development.			
2.1	**Identify new connections**					
2.1.1	*Multimodal connections*	To increase connections by all modes and remove connectivity barriers.	Change in number of multi-modal connections across corridor.	Corridor Study Area - "Corridor Map"	Sidewalks that cross corridor.	
2.2	**Improving urban form/places**					
2.2.1	*Impacts of traffic, congestion, or character on/to adjacent districts*	Reduce potential negative impacts of traffic on adjacent neighborhoods	Average vehicle speed of abutting corridor travel lane AND average volume of queued cars during peak and non-peak periods	Select paths in study area	CTPS AM & PM Peak Speeds for select neighborhood paths and Synchro queue lengths for key intersections	Ratio of average of queue lengths to AM & PM Peak Speeds
2.2.2	*Buffers between travel lanes and communities.*	Buffers between travel lanes and communities.	Ratio of travel lanes to non-travel lanes in the corridor.	McGrath highway	Cross section at A-A	A ratio of footage of sidewalk, parking, median, etc as compared to travel lanes in the corridor
					Cross section at B-B	A ratio of footage of sidewalk, parking, median, etc as compared to travel lanes in the corridor
2.2.3	*Appropriate scale, massing, and form for new development*	Potential blocks for new development	Potential blocks of 20,400 sf each.	Corridor Study Area - "Corridor Map"	CAD	20,000 ft^2 assumed to be minimum lot size for greater development - allows for capacity of multiple alternate uses.
2.2.4	*View corridors and incorporation into placemaking*	Visual connections across corridor	Count of streets that cross McGrath at grade -- they provide a visual connection between neighborhoods.	McGrath Highway	View corridors defined as streets that cross McGrath at grade.	Count of streets that cross McGrath at grade.
2.3	**Improve access to open space**					
2.3.1	*Acreage of open space*	Potential new open space.	Acreage of potential open space.	Neighborhoods that abut corridor: East Somerville Prospect Hill Ten Hills Union Square/Beacon Street Winter Hill East Cambridge	GIS network analysis: CAD drawings	Change reflects new green space on corridor.
2.3.2	*Sidewalk space*	Potential sidewalk space	Acreage of sidewalk	Corridor Study Area - "Corridor Map"	CAD	Acreage of sidewalks in the corridor area.
2.3.3	*Pedestrian connections to open space*	Increase corridor neighborhoods' access to open space	Corridor residents' access to open space.	Corridor Study Area - "Corridor Map"	Network analysis	Average distance from major intersections in corridor to open space (defined as 8' wide or greater) in focus area.
2.3.4	*Roadway Width Crossing*	Improve pedestrian access amenities	Change in average width of travel lane crossing; crossings identified in 2.1.1	McGrath highway	CAD drawings & analysis	Estimated linear feet of active travel lanes that pedestrians must cross to get across McGrath.

2035 No Build	Boulevard			Access Road			Hybrid U-Turn/Rotary			Boulevard & Inner Belt Rd		
Value	Ranking	Value	Change	Ranking	Value	Change	Ranking	Value	Change	Ranking	Value	Change
7		9	2		6	-1		7	0		9	2
10.0		11.9	1.8		5.2	-4.8		6.0	-4.0		7.6	-2.5
0.55 ft		1.56 ft	1.02 ft		1.61 ft	1.06 ft		1.19 ft	0.65 ft		1.56 ft	1.02 ft
0.44 ft		0.58 ft	0.14 ft		0.60 ft	0.16 ft		0.61 ft	0.17 ft		0.58 ft	0.14 ft
0		16	16		15	15		15	15		16	16
4		6	2		4	0		4	0		6	2
37.52 acres		39.56 acres	2.04 acres		39.93 acres	2.41 acres		39.12 acres	1.60 acres		39.56 acres	2.04 acres
4.47 acres		4.85 acres	0.38 acres		4.88 acres	0.41 acres		4.96 acres	0.49 acres		4.85 acres	0.38 acres
965.31 ft		156.15 ft	-809.15 ft		162.00 ft	-803.31 ft		322.54 ft	-642.77 ft		156.15 ft	-809.15 ft
84.92 ft		76.60 ft	-8.32 ft		91.00 ft	6.08 ft		76.50 ft	-8.42 ft		76.60 ft	-8.32 ft

No.	Goal & Objective	Description	Criteria	Geography	Inputs	Methodology/Details
			WORSE / SAME / BETTER		Compared to 2035 No Build	
2.4	**Support and/or generate economic development**					
2.4.1	***Long-term economic development implications***					
2.4.1.1	*Real Estate: Vacancy rates, Property values, Lease Rates*	Improve quality of real estate investments	Change in vacancy rates, property values, and lease rates	Study Area Neighborhoods: Central Davis E. Cambridge E. Medford E. Somerville Fresh Pond Harvard Inner Belt/Brickbottom Kendall/MIT Medford Hillside North Cambrdige North Medford South Medford Spring Hill Union Square West Medford/Medford Square Winter Hill	Market analysis & GIS	Ranked on a scale of 1-10, based on travel times, visibility, access and environmental quality. For detailed methodology, please see tab marked 2.4.1.1-2.4.1.4
2.4.1.2	*Economic Activity: Employment, Sales, Revenues*	Improve economic opportunity	Change in jobs, sales receipts, propety taxes		Market analysis & GIS	
2.4.1.3	*Financial Impact: Transportation access*	Improving corridor access to/from markets	Volume of trips on McGrath portions with on-street parking	McGrath highway	CTPS: Volume Summary & Street Diagram.	Sum of peak period volumes on McGrath portions that will add parking. (See 3.3.3 for parking)
2.4.1.4	*Financial Impact: User cost*	Reducing transportation costs for all users	Change in gross user delay	McGrath intersections - Rt 28 & Somerville, & Medford, & Washington Street.	Synchro output, TTI info	Delay in corridor per day (aggregate Synchro AM & PM peak hour) quantified by cost of delay in Boston.

2035 No Build	Boulevard			Access Road			Hybrid U-Turn/Rotary			Boulevard & Inner Belt Rd		
Value	Ranking	Value	Change	Ranking	Value	Change	Ranking	Value	Change	Ranking	Value	Change
4	●	9	5	◔	5	-1	◕	8	4	●	9	5
2	●	9	7	◔	5	-3	◕	8	6	●	9	7
29,528	◔	20,572	-30.33%	◔	25,341	-14.18%	◔	21,834	-26.06%	◔	19,449	-34.13%
$27.59	◕	$17.38	-$10.21	●	$7.00	-$20.59	●	$11.34	-$16.25	◕	$15.11	-$12.48

No.	Goal & Objective	Description	Criteria	Geography	Inputs	Methodology/Details
			WORSE / SAME / BETTER		Compared to 2035 No Build	
3	**IMPROVE AND BALANCE FUNCTIONALITY**		Ensure cost-effective and efficient use of many modes			
3.1	**Enhance safety for all modes**					
3.1.1	*Vehicle speeds*	Reduce injuries and fatalities in corridor	Change in average vehicular speed	Study Area Neighborhoods	CTPS Model Output: Summary of Average Speed	Average of AM & PM peak period speeds
3.1.2	*Vehicle speeds at "gateway" links*	Reduce injuries and fatalities in corridor through reduction in vehicle speeds	Change in average vehicular speed on roads around corridor	Select paths around corridor selected -- see attached for map/analysis.	CTPS Travel Time Summary	Average of AM & PM Peak period speeds Average of AM & PM Peak period travel times on select paths
3.2	**Maintain regional travel capacity**					
3.2.2	*Travel time delay at key intersections and links*	Reduce corridor delays by mode	Time devoted to pedestrians in signal cycle timing.	McGrath intersections - see list on 3.2.3 sheet	Synchro output for LOS (PM Peak) by intersection	(Average pedestrian time in signal cycle)/(Average signal cycle time)
3.2.3	*Enhance mobility by making corridor operations more predicatable*	Monitor congestion duration and consistency.	Change in intersection capacity utilization	McGrath intersections - see list on 3.2.3 sheet	Synchro Intersection Output PM Peak hour	Average intersection capacity utilization in corridor
			Median queue length		Synchro Intersection Output AM&PM Peak hour	50th percentile queue length
			90th percentile queue length		Synchro Intersection Output AM&PM Peak hour	90th percentile queue length
			Difference between average and longest queue		Synchro Intersection Output AM& PM Peak hour	Difference between 50th percentile and 90th percentile queue length
3.3	**Impacts on surrounding roadways**					
3.3.1	*Functional capacity of neighborhood roadways*	Consider ~~Preserve or enhance~~ capacity of roads crossing corridor	Measure of capacity change on streets that cross corridor	Streets in Corridor Study Area (see tab marked "Corridor Map"): Cross, Medford, Linwood, Somerville, Washington	CTPS "Volume Summary"	Peak AM & PM period aggregated
3.3.2	*New or improved connections*		Total volume of all roadways that travel completely through or across the corridor	3.3.1 and McGrath Highway	CTPS "Volume Summary"	Peak AM & PM period aggregated
3.3.3	*Parking and loading access*	Improve beginning and end of trip capacity	Parking on McGrath	McGrath highway	Additional parking on McGrath	Length of Boulevard segments with parking (ft). Measured from Utile renderings.

2035 No Build	Boulevard			Access Road			Hybrid U-Turn/Rotary			Boulevard & Inner Belt Rd		
Value	Ranking	Value	Change	Ranking	Value	Change	Ranking	Value	Change	Ranking	Value	Change
22.2 mph	◑	22.0 mph	-0.1 mph	◑	22.0 mph	-0.1 mph	◑	22.1 mph	-0.1 mph	◑	22.0 mph	-0.1 mph
19.5 mph	◑	17.9 mph	1.6 mph	◑	18.0 mph	1.5 mph	◑	18.0 mph	1.5 mph	◑	18.0 mph	1.5 mph
2.21 secs	◑	2.38 secs	0.18 secs	◑	2.46 secs	0.26 secs	◑	2.37 secs	0.16 secs	◑	2.36 secs	0.15 secs
0.31	◕	0.54	0.23	●	0.91	0.60	●	0.73	0.42	◕	0.54	0.23
74.15 %	◔	79.40 %	5.25 %	◕	64.00 %	-10.15 %	●	56.27 %	-17.88 %	◕	63.06 %	-11.09 %
196 ft	◔	212 ft	17 ft	●	94 ft	-102 ft	◕	108 ft	-87 ft	◕	136 ft	-59 ft
262 ft	◑	271 ft	9 ft	●	159 ft	-103 ft	●	161 ft	-100 ft	◕	182 ft	-80 ft
66 ft	◑	58 ft	8 ft	◑	65 ft	-1 ft	◑	53 ft	-13 ft	◑	65 ft	-1 ft
12,420	◕	11,744	-676	○	14,951	2,531	◔	13,550	1,130	○	15,784	3,364
62,250	●	48,069	-14,181	◕	55,977	-6,273	●	51,672	-10,578	●	51,113	-11,137
1,804 ft	●	2,348 ft	544 ft	●	2,612 ft	808 ft	◔	1,755 ft	-49 ft	●	2,348 ft	544 ft

No.	Goal & Objective	Description	Criteria	Geography	Inputs	Methodology/Details
					Compared to 2035 No Build	
4	**PROVIDE ACCOUNTABILITY**	Advance a final design that is sensitive to the needs and desires of stakeholders				
4.1	**Share benefits and burdens of changes**					
4.1.1	*Vehicle hours traveled in the region*	Potential for corridor mobility to benefit as many people as possible	Change in VHT by neighborhood	Focus Area Neighborhoods: East Cambridge East Somerville Inner Belt/Brickbottom Kendal/MIT Union Square Winter Hill	CTPS model / GIS analysis	VHT by neighborhood from CTPS Air Quality Results - for neighborhoods in "focus area"
4.1.2	*Impacts on Environmental Justice populations*	Specifically analyzing impacts on EJ populations	EJ populations affected by vehicles traveling through the study area		GIS network analysis	VHT by neighborhood*Percentage of population that is EJ
4.2	**Limit impact to environment**					
4.2.1	*Air quality/carbon footprint (VMT and GhG)*	Effect no change or improve greenhouse gas emissions	Change in corridor CO2	Study Area Neighborhoods: Central Davis E. Cambridge E. Medford E. Somerville Fresh Pond Harvard Inner Belt/Brickbottom Kendall/MIT Medford Hillside North Cambrdige North Medford South Medford Spring Hill	CTPS Summary of Air Quality Results	Aggregate AM & PM Peak
4.2.2	*Stormwater impacts (flooding and runoff)*	Potential pervious surface	Square footage of open space in corridor	Neighborhoods that abut corridor: East Somerville Prospect Hill Ten Hills Union Square/Beacon Street Winter Hill East Cambridge	Green space numbers from Utile CAD drawings, exisiting conditions report.	Open space minimum 8 ft wide.
4.2.3	*Other environmental resources to be impacted*	Effect no net impact on native species and green space	Count of removed trees, new trees, and green space acreage from 2.3.1	Neighborhoods that abut corridor: East Somerville Prospect Hill Ten Hills Union Square/Beacon Street Winter Hill East Cambridge	GIS network analysis	Uses general rule of thumb: Mix of Elm & Plum trees = 20 trees/acre Multiplied by acres of green space from 2.3.1
4.3	**Ensure long-term corridor maintainability**					
4.3.1	*Feasible maintenance plan for corridor*	Ensure a sustainable maintenance program	Average annual maintenance costs per mile versus MassDOT urban roadway average		MassDOT analysis	
4.3.2	*Fiscal impacts of alternatives*	Ensure investment is outweighed by economic gain	Sustainable ROI calculation		MassDOT, market & Census data	
4.3.3	*Cost to construct*			McGrath viaduct	Cost Analysis	Appendix N

SUMMARY OF RANKINGS

2035 No Build	Boulevard			Access Road			Hybrid U-Turn/Rotary			Boulevard & Inner Belt Rd		
Value	Ranking	Value	Change	Ranking	Value	Change	Ranking	Value	Change	Ranking	Value	Change
15,312 VHT	◕	15,140 VHT	-172 VHT	◑	15,278 VHT	-34 VHT	◕	15,201 VHT	-111 VHT	◕	15,138 VHT	-174 VHT
14,430 VHT	●	14,285 VHT	-144 VHT	◑	14,426 VHT	-3 VHT	◕	14,346 VHT	-83 VHT	●	14,292 VHT	-138 VHT
692,843 kg	◕	688,390 kg	-4,453 kg	◕	689,347 kg	-3,496 kg	◕	689,097 kg	-3,746 kg	◕	688,596 kg	-4,247 kg
1,634,371 sf	◕	1,723,301 sf	88,930 sf	●	1,739,486 sf	105,115 sf	◕	1,703,959 sf	69,588 sf	◕	1,723,301 sf	88,930 sf
750 trees	◕	791 trees	41 trees	◕	799 trees	48 trees	◕	782 trees	32 trees	◕	791 trees	41 trees
	◕			◕			◕			◕		
	◕			◕			◕			◕		
	◕			◕			◕			◔		
	36 ● Boulevard			*29* ◕ Access Road			*36* ● Hybrid U-Turn/Rotary			*38* ● Boulevard & Inner Belt Road		

demand model are presented in Appendix J, and provided sufficient information regarding the extent of these diversions for them to be qualitatively considered in the Evaluation Matrix. However, understanding the full impacts of diverted trips on intersections and roadways outside of the study area will require additional consideration from a capacity and public policy perspective if a selected alternative advances to conceptual design.

- No alternative completely solves the vehicular traffic issues throughout the McGrath corridor. Modifying the McGrath corridor to an at-grade roadway from a grade-separated highway introduces added traffic to the corridor intersections. As discussed previously, the alternatives were selected primarily to help make the McGrath corridor more livable in terms of serving multiple modes of transportation users and giving less priority to the speed and efficiency of vehicular traffic.
- Some alternatives have significant queuing at intersections, with a potential for spill back that could lead to unacceptable conditions. Additional evaluation of these intersections is warranted if an alternative proceeds to preliminary design.

The key issues and opportunities from a vehicular circulation perspective for each alternative are provided below:

Boulevard Alternative

A summary of the capacity analysis for the Boulevard Alternative is provided in Table 5-2.

Opportunities

- The alternative would result in improved or maintained overall traffic operations compared to the No Build at the following existing intersections with the McGrath corridor:
  - » Blakeley Avenue
  - » Broadway
  - » Pearl Street
  - » Medford Street/Highland Avenue
  - » Medford Street at Somerville Avenue
  - » Rufo Road
  - » Land Boulevard/Austin Street
- Besides the Washington Street intersection, this alternative provides “normalized” intersection operations at reconfigured at-grade intersections by implementing conventional intersection designs. A “normalized” intersection configuration would include straightforward and simple vehicular movements as well as simplified signal phasing, eliminating potential confusion to vehicles traveling within the McGrath corridor. The Boulevard alternative would provide vehicles traveling along the McGrath corridor and its intersecting roadways with the ability to more easily and directly navigate the newly configured intersections, rather than the somewhat confusing existing and No Build configurations of ramps, surface roads, and underpasses.
- Would allow for full access between the McGrath corridor, Somerville Avenue and Poplar Street that is not permitted under existing conditions.
- The following assumptions and improvements would likely provide additional capacity and better traffic operations for the proposed Boulevard Alternative:
  - » Trip diversions from Washington Street may be possible with potential new Inner Belt connections.
  - » Additional eastbound and westbound through lanes.
  - » Adding exclusive, channelized right turn lanes on the northbound and southbound approaches, rather than a shared right-turn and through lane.

Issues

- Trip diversions to other area roadways are assumed as a result of the reduced capacity on the McGrath corridor. Due to the change in vehicle capacity along the McGrath corridor and the resulting reduction in congested travel speed, the CTPS regional travel demand model indicates that some vehicles may seek alternate routes in order to travel on roads with more available capacity. As a result, volumes are projected to increase on Broadway and Land Boulevard, which have impacts on the cross streets with these roadways. The increases on Land Boulevard and Broadway indicate that vehicles may be expected to travel along Rutherford Avenue and other regional roadways instead of the McGrath corridor in order to reach their destinations.

Table 5-2: Boulevard Capacity Analysis

Location	Peak Hour		2011 Existing LOS[1]	2011 Existing Delay[2]	2011 Existing V/C[3]	2035 No Build LOS	2035 No Build Delay	2035 No Build V/C	Boulevard 2035 LOS	Boulevard 2035 Delay	Boulevard 2035 V/C
Route 28 at Land Boulevard/Austin Street	AM	Overall	F	89.4	1.78	E	68.0	1.10	E	76.0	1.07
	PM	Overall	F	94.3	1.32	F	90.4	1.2	F	92.6	1.26
Route 28 at Land Cambridge Street/East Street	AM	Overall	B	18.4	0.74	B	15.5	0.7	C	26.1	0.59
	PM	Overall	C	23.1	0.73	B	17.5	0.56	C	20.1	0.4
Route 28 at Third Street	AM	Overall	C	24.8	0.85	C	28.5	0.68	A	9.6	0.57
	PM	Overall	C	30.2	0.86	C	33.8	0.94	C	27	0.85
Route 28 at Rufo Street	AM	Overall	C	23.8	0.71	C	28.5	0.68	A	8.8	0.66
	PM	Overall	D	40.7	1.41	D	35.8	0.93	C	28.3	0.9
Medford Street at Somerville Avenue	AM	Overall	C	31.3	0.76	C	34.4	0.82	C	32.6	0.83
	PM	Overall	D	47.4	1.04	E	72	1.28	D	36.8	0.89
Route 28 at Somerville Avenue/Poplar Rd	AM	Overall	n/a	n/a	n/a	n/a	n/a	n/a	C	23.7	0.83
	PM	Overall	n/a	n/a	n/a	n/a	n/a	n/a	D	49.3	0.89
Route 28 at Washington Street	AM	Overall	C	29.7	0.88	E	57.4	1.24	F	210.5	1.33
	PM	Overall	E	57.1	0.88	E	75	2.36	F	116.4	1.32
Route 28 at Medford Stret/Highland Street	AM	Overall	F	84.8	1.26	F	101.2	1.31	C	22.3	0.91
	PM	Overall	D	45.4	1.19	E	56.2	1.14	C	27	0.92
Route 28 at Pearl Street	AM	Overall	C	30.3	0.86	E	55.8	1.08	C	30.1	0.86
	PM	Overall	D	42.9	0.87	D	43.5	0.98	B	19.7	0.83
Route 28 at Broadway	AM	Overall	D	51.9	1.22	E	69.9	1.06	D	42.9	0.91
	PM	Overall	D	48.2	0.96	D	52	0.98	D	42.9	0.91
Route 28 at Blakeley Avenue	AM	Overall	A	6.6	0.54	A	7.9	0.64	A	5.5	0.55
	PM	Overall	A	8.9	0.62	A	9.2	0.68	A	8.2	0.72

1 Level-of-Service

2 Average delay in seconds per vehicle

3 Volume to capacity ratio

Table 5-3: U-Turn/Rotary Hybrid Analysis

Location	Peak Hour		2011 Existing LOS[1]	2011 Existing Delay[2]	2011 Existing V/C[3]	2035 No Build LOS	2035 No Build Delay	2035 No Build V/C	Uturn/Rotary 2035 LOS	Uturn/Rotary 2035 Delay	Uturn/Rotary 2035 V/C
Route 28 at Land Boulevard/Austin Street	AM	Overall	F	89.4	1.78	E	68.0	1.10	E	70.5	1.05
	PM	Overall	F	94.3	1.32	F	90.4	1.2	F	92.50	1.26
Route 28 at Land Cambridge Street/East Street	AM	Overall	B	18.4	0.74	B	15.5	0.7	C	29.7	0.61
	PM	Overall	C	23.1	0.73	B	17.5	0.56	B	23.00	0.85
Route 28 at Third Street	AM	Overall	C	24.8	0.85	C	28.5	0.68	B	11.8	0.64
	PM	Overall	C	30.2	0.86	C	33.8	0.94	C	30.50	0.90
Route 28 at Rufo Street	AM	Overall	C	23.8	0.71	C	28.5	0.68	B	13.8	0.56
	PM	Overall	D	40.7	1.41	D	35.8	0.93	C	33.10	0.91
Medford Street at Somerville Avenue	AM	Overall	C	31.3	0.76	C	34.4	0.82	n/a	n/a	n/a
	PM	Overall	D	47.4	1.04	E	72	1.28	n/a	n/a	n/a
Route 28 at Southern Rotary/Access Road	AM	Overall	n/a	n/a	n/a	n/a	n/a	n/a	B	15.4	0.87
	PM	Overall	n/a	n/a	n/a	n/a	n/a	n/a	B	17.6	0.81
Route 28 at Northern Rotary/Access Road	AM	Overall	n/a	n/a	n/a	n/a	n/a	n/a	B	11.4	0.87
		WB T	n/a	n/a	n/a	n/a	n/a	n/a	D	45.2	0.52
Poplar Street at Rotary/Access Rd	AM	WB R	n/a	n/a	n/a	n/a	n/a	n/a	B	11.6	0.14
	PM	WB R	n/a	n/a	n/a	n/a	n/a	n/a	B	14.5	0.22
Somerville Avenue at Rotary/Access Rd	AM	EB R	n/a	n/a	n/a	n/a	n/a	n/a	F	82.6	0.92
	PM	EB R	n/a	n/a	n/a	n/a	n/a	n/a	F	191.80	1.35
Medford Street at Rotary/Access Rd	AM	NB TR	n/a	n/a	n/a	n/a	n/a	n/a	F	105	1.07
	PM	NB TR	n/a	n/a	n/a	n/a	n/a	n/a	F	191.80	1.35
Route 28 at Linwood Street	AM	Overall	n/a	n/a	n/a	n/a	n/a	n/a	C	20.7	0.87
	PM	Overall	n/a	n/a	n/a	n/a	n/a	n/a	C	32.6	0.91
Route 28 at Northern U-Turn	AM	Overall	n/a	n/a	n/a	n/a	n/a	n/a	A	7.2	n/a
	PM	Overall	n/a	n/a	n/a	n/a	n/a	n/a	B	10.3	0.78
Route 28 at Washington Street	AM	Overall	C	29.7	0.88	E	57.4	1.24	C	20.4	0.78
	PM	Overall	E	57.1	0.88	E	75	2.36	C	20.90	0.88
Route 28 at Medford Stret/Highland Street	AM	Overall	F	84.8	1.26	F	101.2	1.31	B	15.7	0.93
	PM	Overall	D	45.4	1.19	E	56.2	1.14	A	18.60	0.76
Route 28 at Pearl Street	AM	Overall	C	30.3	0.86	E	55.8	1.08	D	46.7	1.1
	PM	Overall	D	42.9	0.87	D	43.5	0.98	D	43.30	1.23
Route 28 at Broadway	AM	Overall	D	51.9	1.22	E	69.9	1.06	D	44.9	0.91
	PM	Overall	D	48.2	0.96	D	52	0.98	D	43.30	0.88
Route 28 at Blakeley Avenue	AM	Overall	A	6.6	0.54	A	7.9	0.64	D	35.30	0.82
	PM	Overall	A	8.9	0.62	A	9.2	0.68	A	8.90	0.59

1 Level-of-Service

2 Average delay in seconds per vehicle

3 Volume to capacity ratio

- To improve intersection operations, the northbound and southbound left-turns from the McGrath corridor to Washington Street are prohibited in this alternative. The existing conditions show that there is a relatively low demand for these turns. Restricting the left turns will require vehicles to seek alternate routes within the study area to travel to their destinations. Northbound vehicles traveling towards Union Square would be required to turn left onto Somerville Avenue (at the new signalized location) and travel northwest to reach their destination. Southbound vehicles wishing to travel eastbound on Washington Street towards Sullivan Square would need to turn left onto Poplar Street (at the new signalized location) and travel north to turn right onto Washington Street and continue to the east.
- The intersection of the McGrath corridor and Washington Street would operate at an overall LOS F with many approaches operating over-capacity including the eastbound and westbound Washington Street approaches during both analyzed peak hours. The southbound McGrath corridor approach is shown to operate at LOS F during the weekday morning peak hour while the northbound McGrath corridor approach is shown to operate at LOS D during the weekday afternoon peak hour. Additional capacity analysis results can be found in Appendix E.
- Providing an acceptable LOS (LOS D or better) would require capacity changes at the intersection of the McGrath corridor and Washington Street. This added capacity would increase the pavement cross-section and run counter to the "Road Diet" and Complete Streets approach that are the basis of the Working Group's request to explore this alternative. Therefore, modifications to increase capacity at the intersection were not further analyzed.
- The proximity of the signalized intersections on the McGrath corridor at Washington Street and at Linwood Street would result in queuing issues, specifically the northbound approach at Washington Street during the weekday afternoon peak hour when queue lengths are projected to extend back into the Linwood Street intersection. This situation would result in gridlock that would potentially block vehicles exiting and entering Linwood Street, further degrading traffic operations.
- Under the Boulevard alternative, the McGrath corridor/Somerville Ave/Medford Street/Poplar Street intersection presents a number of challenges with the coordination of the two closely spaced signals, including the following:
  - » Minimal vehicle queue storage between the two coordinated traffic signals (Somerville Avenue at Medford Street and McGrath corridor at Poplar Street). The two signals would essentially need to operate as one in order to eliminate the possibility of vehicles queuing in the eastbound and westbound directions between the signals. The configuration of the two intersections requires complex signal and roadway design in order to ensure safe and efficient operations and to limit potential driver confusion.
  - » Potentially high volume of eastbound left turns from Somerville Avenue to the McGrath corridor northbound would further complicate the inability to store vehicles between the two intersections. The eastbound left turn is also expected to operate at LOS F with a queue length in excess of 500 feet during the weekday afternoon peak hour. Additional details of the capacity analysis including level of service, delay, capacity and queuing can be found In Appendix E.

U-turn/Rotary Hybrid Alternative

A summary of the capacity analysis for the U-turn/Rotary Hybrid Alternative is provided in Table 5-3.

Opportunities

- This alternative would provide new roadway connections between the McGrath corridor and Inner Belt/Brickbottom, Somerville Avenue, Union Square, as well as additional pedestrian connections across the McGrath corridor not possible today.
- As noted previously, all alternatives assume that there would be some level of traffic diversion compared to the No Build condition, as indicated through the use of the CTPS regional travel demand model. During the weekday morning analysis, the southbound McGrath corridor traffic volumes show less of a decrease along the entire corridor than under the Boulevard alternative. This smaller decrease in traffic volumes under the U-turn/ Rotary Hybrid Alternative is due to some level of

improvement on both capacities and speed at the intersections and rotary compared to the Boulevard Alternative.

- Attaining an acceptable operational traffic LOS during the weekday morning and weekday afternoon peak hours at the McGrath corridor and Washington Street intersection is possible with the use of a simplified two phase traffic signal. This would maintain through access of eastbound and westbound Washington Street approaches and streamline vehicular operations at this intersection.
- Acceptable traffic operations at the new signalized rotary intersections would be expected. However, 95th percentile queues would slightly exceed the maximum storage length available, but could potentially be addressed through more advanced design in the future if this is the preferred alternative.
- There would be a slight decrease in the traffic volumes on Medford Street in the vicinity of Somerville Avenue, compared to the Boulevard Alternative during the weekday morning and weekday afternoon peak hours. This may be attributed to the combination of improved traffic flow on the McGrath corridor and the increased travel time to access Medford Street via the rotary. Vehicles are more likely to remain on the McGrath corridor instead of using Medford Street as an alternative route.
- Compared to the No Build, this alternative would combine the intersection of the McGrath corridor and Linwood Street and the southbound McGrath corridor U-turn.
  - » Linwood Street right-out exiting and full access entering would be allowed
  - » Would eliminate a potential additional traffic signal along the McGrath corridor
  - » Would create an opportunity for a pedestrian crossing that could run concurrently with the southbound U-turn
- Compared to the No Build, this alternative would improve or maintain overall traffic operations at the following existing intersections with the McGrath corridor:
  - » Blakeley Avenue
  - » Broadway
  - » Medford Street/Highland Avenue
  - » Would improve the LOS due to elimination of the eastbound Medford Street left turn, which would result in a number of vehicles diverting from the intersection.
  - » Rufo Road
  - » Third Street
  - » Land Boulevard/Austin Street

Issues

- The left-turn restriction from Medford Street/Highland Avenue to the northbound McGrath corridor would force a significant number of vehicles to shift to the eastbound movement of Pearl Street at its intersection with the McGrath corridor. This diversion would have an impact on both Medford Street, Pearl Street, and the northbound McGrath corridor (north of Medford Street/Highland Avenue). Most notably, this would cause delay at the intersection of Pearl Street and the McGrath corridor. In addition, trips destined to the north may seek alternative routes to avoid McGrath intersections, as reflected in the relatively lower volumes for the northbound approach to Blakely Avenue (as shown in the CTPS results in Appendices I and J) when compared to the No Build and Boulevard alternatives. These diversionary trips would likely have impacts on streets north of Medford Street that need to be considered from a regional perspective.
- Under this alternative, the new signalized U-turn intersection at Cross Street would include a configuration that allows dual U-turn movements where northbound and southbound vehicles would complete their reverse-movement turns at the same time under a protected signal phase. This dual U-turn configuration would improve the operations at the McGrath corridor intersection with Somerville Avenue and Highland/Medford Street. However, providing the dual U-turn configuration complicates the pedestrian crossings at the intersection because they could not run concurrently with the U-turns without additional geometric changes to the intersection. For example, a “slip lane” could be created for the U-turn, providing a small area of median between turning vehicles and pedestrian crossings. However, this would lengthen the overall intersection and sight lines would need to be considered. Additionally, an exclusive pedestrian

phase at the U-turn intersection would cause the intersection to exceed capacity during both the weekday morning and weekday afternoon peak periods. Specific design details regarding the configuration and interaction between vehicles and pedestrians at this new signalized intersection would require further exploration if the alternative proceeds to design.

- The CTPS regional travel demand model showed that during the weekday afternoon peak period, traffic volumes on the southbound McGrath corridor between Medford Street/Highland Avenue and Washington Street are much higher than traffic volumes for the same segment in the Boulevard Alternative. The provision of a southbound left-turn pocket lane between Medford/Highland and Washington Street is viewed by the CTPS model as the equivalent of an additional lane of capacity. Adding the left-turn pockets allows slightly higher congested travel speeds on the through lanes compared to the Boulevard Alternative, which would attract trips using this portion of roadway.
- Signalized intersections along the McGrath corridor at Washington Street, Linwood Street and median U-turns would be closely spaced, and projected to result in spillback issues for vehicle queues into adjacent intersections. This situation would result in gridlock that would potentially block vehicles exiting and entering the side streets, further degrading traffic operations.
- The Somerville Avenue and Medford Street yield controlled approaches to the rotary would operate at LOS F during the weekday morning and weekday afternoon peak hour. The projected queue lengths for a yield approach would likely exceed the capacity of the intersection. Widening each of these approaches to include two travel lanes is expected to improve operations, but would require additional roadway width.
- Some of the yield approaches to the signalized rotary would operate with significant delay and queuing.
  - » Medford Street would operate at LOS F during the weekday morning and weekday afternoon peak hours.
  - » The Somerville Avenue approach would operate at LOS F during the weekday morning peak hour.

Linwood Access Road

A summary of the capacity analysis for the Linwood Access Road Alternative is provided in Table 5-4.

Opportunities

- Compared to the No Build, this alternative would result in acceptable operations at both signalized and unsignalized access road intersections, with the exception of Medford Street during the weekday afternoon peak.
- Compared to the No Build, this alternative would improve capacity for through movements on the McGrath corridor due to the consolidation of conflict points with traffic from intersection roadways.
- Compared to the No Build, this alternative would improve or maintain overall traffic operations at the following existing intersections with the McGrath corridor:
  - » Blakeley Avenue
  - » Broadway
  - » Medford Street/Highland Avenue
  - » Rufo Road
  - » Third Street
  - » Land Boulevard/Austin Street
- A northbound access road would be incorporated through existing Brickbottom roadways, improving access and connectivity to local roadways in the area.

Issues

- Washington Street eastbound/westbound through movements would be circulated through the access road.
  - » The new alignment requires eastbound Washington Street through movements to be circuitously routed a longer distance through three signals, an addition of almost 0.5 miles to this movement compared to existing conditions and the No Build.
  - » May divert additional eastbound traffic to

Table 5-4: Linwood Access Road Capacity Analysis

Location	Peak Hour		2011 Existing LOS[1]	2011 Existing Delay[2]	2011 Existing V/C[3]	2035 No Build LOS	2035 No Build Delay	2035 No Build V/C		Access Rd 2035 LOS	Access Rd 2035 Delay	Access Rd 2035 V/C
Route 28 at Land Boulevard/Austin Street	AM	Overall	F	89.4	1.78	E	68.0	1.10	Overall	E	77.4	1.18
	PM	Overall	F	94.3	1.32	F	90.4	1.2	Overall	F	90.00	1.20
Route 28 at Land Cambridge Street/East Street	AM	Overall	B	18.4	0.74	B	15.5	0.7	Overall	B	19.1	0.58
	PM	Overall	C	23.1	0.73	B	17.5	0.56	Overall	B	19.80	0.48
Route 28 at Third Street	AM	Overall	C	24.8	0.85	C	28.5	0.68	Overall	B	0.64	1.71
	PM	Overall	C	30.2	0.86	C	33.8	0.94	Overall	B	27.50	0.87
Route 28 at Rufo Street	AM	Overall	C	23.8	0.71	C	28.5	0.68	Overall	B	12.2	0.63
	PM	Overall	D	40.7	1.41	D	35.8	0.93	Overall	C	33.00	0.91
Medford Street at Somerville Avenue	AM	Overall	C	31.3	0.76	C	34.4	0.82	Overall	n/a	n/a	n/a
	PM	Overall	D	47.4	1.04	E	72	1.28	Overall	n/a	n/a	n/a
Route 28 at Somerville Avenue/Poplar Rd	AM	Overall	n/a	n/a	n/a	n/a	n/a	n/a	Overall	n/a	n/a	n/a
	PM	Overall	n/a	n/a	n/a	n/a	n/a	n/a	Overall	n/a	n/a	n/a
Route 28 at Southern Rotary/Access Road	AM	Overall	n/a	n/a	n/a	n/a	n/a	n/a	Overall	B	15.1	0.79
	PM	Overall	n/a	n/a	n/a	n/a	n/a	n/a	Overall	B	16.5	0.84
Route 28 at Northern Rotary/Access Road	AM	Overall	n/a	n/a	n/a	n/a	n/a	n/a	Overall	B	17.6	0.97
	PM	Overall	n/a	n/a	n/a	n/a	n/a	n/a	Overall	C	26.8	0.95
Poplar Street at Rotary/Access Rd	AM	WB R	n/a	n/a	n/a	n/a	n/a	n/a	n/a	B	11.3	0.13
	PM	WB R	n/a	n/a	n/a	n/a	n/a	n/a	n/a	C	15.8	0.25
Somerville Avenue at Rotary/Access Rd	AM	EB R	n/a	n/a	n/a	n/a	n/a	n/a	n/a	D	33.9	0.71
	PM	EB R	n/a	n/a	n/a	n/a	n/a	n/a	n/a	E	43	0.85
Medford Street at Rotary/Access Rd	AM	EB R	n/a	n/a	n/a	n/a	n/a	n/a	n/a	B	13	0.34
	PM	EB R	n/a	n/a	n/a	n/a	n/a	n/a	n/a	F	55.10	0.91
Route 28 at Washington Street	AM	Overall	C	29.7	0.88	E	57.4	1.24	Overall	n/a	n/a	n/a
	PM	Overall	E	57.1	0.88	E	75	2.36	Overall	n/a	n/a	n/a
Washington Street WB at Rotary/Access Rd	AM	WB R	n/a	n/a	n/a	n/a	n/a	n/a	n/a	C	17.4	0.65
	PM	WB R	n/a	n/a	n/a	n/a	n/a	n/a	n/a	D	32.4	0.85
Washington Street EB at Rotary/Access Rd	AM	EB R	n/a	n/a	n/a	n/a	n/a	n/a	n/a	C	18.9	0.39
	PM	EB R	n/a	n/a	n/a	n/a	n/a	n/a	n/a	C	19.4	0.49
Route 28 at Medford Stret/Highland Street	AM	Overall	F	84.8	1.26	F	101.2	1.31	Overall	D	37	1
	PM	Overall	D	45.4	1.19	E	56.2	1.14	Overall	C	26.50	0.88
Route 28 at Pearl Street	AM	Overall	C	30.3	0.86	E	55.8	1.08	Overall	C	28.4	0.9
	PM	Overall	D	42.9	0.87	D	43.5	0.98	Overall	D	37.80	0.82
Route 28 at Broadway	AM	Overall	D	51.9	1.22	E	69.9	1.06	Overall	D	54.2	0.99
	PM	Overall	D	48.2	0.96	D	52	0.98	Overall	E	49.20	0.95
Route 28 at Blakeley Avenue	AM	Overall	A	6.6	0.54	A	7.9	0.64	Overall	A	5.70	0.52
	PM	Overall	A	8.9	0.62	A	9.2	0.68	Overall	A	8.80	0.58

1 Level-of-Service

2 Average delay in seconds per vehicle

3 Volume to capacity ratio

Somerville Avenue in order to shorten the length of the trip to travel eastbound on Washington Street.

- There is some trip diversion shown in the CTPS regional travel demand model for traffic that would originally be using Washington Street eastbound and shifting to Highland Avenue/Medford Street eastbound in order to travel northbound on the McGrath corridor. This would impact local roadways west of McGrath and would need to be considered from a regional perspective.
- Locating the pedestrian crossings at the signalized access road intersections would prevent direct pedestrian access along Washington Street or from Somerville Avenue to the Inner Belt/Brick Bottom area.
- Eastbound queuing at the southern access road intersection near Somerville Avenue, and westbound 95th percentile queuing at the northern access road intersection near Washington Street would extend beyond the available storage length. Slight improvements could be possible with a reconfiguration of the access road geometry, but would have impacts on adjacent properties.
- For this alternative, the smallest amount of traffic is diverted from along the McGrath corridor and greatest amount of traffic is diverted from Washington Street when compared to the other alternatives.
- The travel to and from McGrath to the intersecting east/west streets increases under this alternative, therefore increasing overall travel time for local trips.

Summary of Pedestrian and Bicyclist Issues

Mobility for pedestrians and bicycles are included in the Evaluation Matrix through a variety of measures.

- All alternatives improve the comprehensiveness of the pedestrian and cycling network compared to the No Build. All Build alternatives are assumed to include facilities such as sidewalks, bicycle lanes or shared lane markings between activity centers along the McGrath corridor.
- The presence of alternative modal connections would be the greatest for the Boulevard and IBBB options, although the Linwood Access Road and U-turn/Rotary alternatives would also provide improvements compared to the No Build condition. The ability to change mode share is based on cost and convenience, and these alternatives facilitate transfers with improved connections.
- In terms of sidewalk connectivity, the average block length would decrease slightly for the Boulevard Alternative and more significantly for the U-turn/Rotary Alternative, and therefore rates more favorably when compared to the No Build. The Linwood Access Road Alternative would not decrease as significantly, which is due to long block lengths expected in this alternative. The decrease for the U-turn/Rotary Alternative may be due, in part, to new “blocks” forming around the Poplar Street intersection.
- No significant change in travel mode share was evident among the alternatives based on the CTPS regional travel demand model (see Appendix K). The CTPS regional travel demand model shows vehicle trip diversions to outside of the McGrath corridor, but it does not appear that there was a shift to non-vehicular travel. Therefore, all alternatives are comparable to the No Build condition in terms of mode shares. It is important to note that planned transit improvements, such as the GLX, are included in the No Build Alternative which contributes significantly to why there were no substantial mode-shifts in the alternatives.
- All alternatives would increase the ratio of “buffers” between travel lanes and communities (i.e. parking, sidewalks, bike lanes, green space) to travel lanes. The U-turn/Rotary does not rank as well as the other alternatives for the sample cross sections shown previously due to the wider cross-sections at signalized intersections, but otherwise all alternatives are comparable in this regard.
- All alternatives would provide significantly better neighborhood connections to open space, than compared to the No Build condition. The barrier created by an elevated McGrath corridor is removed for the alternatives, improving pedestrian crossings to access the parks and playgrounds adjacent to the McGrath corridor.
- Based on the estimated linear feet of active travel lanes that pedestrians must walk to get across the

McGrath corridor, the Boulevard Alternative performs best for the roadway width crossing criterion. While both the Boulevard and U-turn/Rotary alternatives would decrease roadway crossing by a little less than one lane, the Linwood Access Road Alternative increases the average width of active travel lanes that pedestrians must cross over the No Build.

Summary of Safety Impacts

The safety analysis includes the examination of impacts on vehicular, bicycle and pedestrian movements in the study area. Vehicular speeds, as a measure of safety for modes of travel, are evaluated for each alternative in section 3.1 of the Evaluation Matrix. Injuries and fatalities can be reduced through reduction in vehicular speeds. The average speed in the No Build Alternative is 19.5 mph, while the three alternatives are all about 18 mph. This does not represent a significant difference in speeds, and therefore no substantial change in safety in terms of vehicular speed.

The existing crash rates identified as part of the existing conditions analysis (see Chapter 2), will likely be influenced by the reconfiguration of the McGrath corridor from an elevated roadway to an at-grade corridor. Congested conditions may lead to additional crashes, particularly rear-end crashes. However, with slightly lower vehicular speeds at key intersections along the McGrath corridor, the severity of these crashes may diminish.

Crash data for existing conditions is presented in Chapter 2. The at-grade alternatives for Grounding McGrath will create new intersections that must be carefully designed to reduce the probably of crashes, particularly the angle type rear-end and bicycle crashes that occur at key intersections.

Potential short-term improvements that could be made to enhance safety for the No Build or any of the Build alternatives include:

- Signal timing adjustments
  - » Extend clearance intervals
  - » Provide additional green time to critical movements
  - » Provide protected signal phasing for critical movements such as left turns
  - » Improve signal coordination
- Lane Restriping
  - » Clearly indicate exclusive movements
  - » Modify intersection configuration to improve capacity
- Roadway Improvements
  - » Repave for non-skid resistance
  - » Improve access management by reducing conflict points
  - » Provide channelization or turn lanes
  - » Improve sight distance

Summary of Environmental Effects

Environmental impacts of alternatives are evaluated through metrics to improve the health of residents through increased pedestrian and bicycling opportunities, access to open space, vehicle hours travelled, and overall impacts to the environment, as noted in the Evaluation Matrix.

All three alternatives are expected to improve carbon monoxide (CO) emissions in the winter, compared to the No Build alternatives. Otherwise, there is no significant difference in air quality measures, based on the data available through the CTPS model Air Quality Results. The *Health Impact Assessment of the Massachusetts Department of Transportation (MassDOT) Grounding McGrath Study* (HIA Study)[1] evaluated air quality within proximity of 200 meters of the roadway (for indirect measure of ultrafine particles and higher gradient of vehicle emissions), using contour maps of the density of vehicle miles travelled (VMT). The findings concluded "All future project alternatives, including the 2035 No Build, will result in significant reductions in traffic-related air pollution largely attributed to advancements in vehicle emissions standards and technologies." The HIA Study goes on to state that, "De-elevation of the highway structure is anticipated to result in an increase in ground-level exposure to traffic-related air pollutant emissions (i.e. criteria pollutants, hazardous air pollutants, ultrafine particles). Thus, implementation of mitigation measures (e.g., locating sidewalks and bike paths further away from the roadway, installation of barriers, planting of

1 April 4, 2013 McGrath Working Group presentation by the Massachusetts Department of Public Health

trees) based on more comprehensive assessment of air pollution impacts should be explored where possible to reduce exposure to traffic related air pollutants."

Noise impacts are a function of distance of noise receptors from the roadway, traffic displacement, vehicular speed, and similar measures. Generally speaking, it can be assumed that an elevated roadway (existing conditions and No Build) will generate more noise than at-grade roadways. Noise is generated by the structure itself as vehicles travel over joints and similar features. In addition, noise is directly affected by line of sight which will extend further for an elevated structure than for at-grade roadways. Finally, the types of barriers on the structure and adjacent land uses also impact noise levels.

The Massachusetts Department of Transportation's Highway Division Type I and Type II Noise Abatement Policy and Procedures (MassDOT Noise Policy) complies with Codified Federal Regulations and have been approved by the Federal Highway Administration (FHWA). The Policy defines two types of highway noise projects , the first of which will be required for any alternative:[2]

- A Type I Noise Barrier is a noise barrier considered as part of new highway construction or when there is a substantial change in the capacity or alignment of an existing highway. Examples of Type I projects include: new highway, substantial horizontal or vertical alignment, addition of a full travel lane and the addition or relocation of interchange ramps.
- The Type II Noise Program addresses highway traffic noise in locations where a Type I project is not planned. The Type II Noise Program is a voluntary program. Type II noise barriers compete for funding with other projects that increase highway safety such as the replacement of structurally deficient bridges, the reconstruction of deteriorated and substandard roadways, and the reconstruction of intersections that are known to be high accident locations.

A review of existing environmental conditions, presented in Chapter 2, indicates that there is not anticipated to be any change in impacts from the No Build and the alternatives for wetlands and waterways, Areas of Critical Environmental Concern (ACEC), hazardous materials sites, historic, cultural and archaeological resources.

Environmental effects are further analyzed through the separate HIA Study. Generally speaking, most environmental impacts associated with the Build alternatives are positive when compared to the No Build. Thresholds for environmental review under the Massachusetts Environmental Policy Act (MEPA) and National Environmental Policy Act (NEPA) may not be triggered, with the exception of overall acreage of the project area and potential changes in alignment of Poplar Street. The project is primarily in the MassDOT right-of-way, with the exception of the potential Poplar Street re-alignment. The City of Somerville has indicated a willingness to work with MassDOT to secure additional right-of-way associated with the Boulevard Alternative (see Appendix L).

Land Use and Economic Development

The potential implications of the alternatives on economic development are included in section 2.4 of the Evaluation Matrix. The key issues considered in the evaluation are described below. Population and employment projections are included in the 2035 No Build condition.

Generally speaking, the Build alternatives will influence land use and economic development in the McGrath corridor:

- New properties would be created by grounding the overpasses, including some public land. A land bank could be maintained for needed uses such as affordable housing.
- Careful planning of the traffic network, including potential land swaps with neighboring properties for grounding the structures, could yield new redevelopment potential.
- Infrastructure costs required to create attractive development may be expensive. With careful

2 Information from MassDOT's Noise Barrier Brochure, 2013. http://www.mhd.state.ma.us/downloads/environ/noisebarrier2012/NoiseBarrierBrochure2013.pdf

planning, Tax Increment Financing, Infrastructure Investment Incentive (I-3) or related district financing could make sure that sources exist for infrastructure costs.

- Speculation on property could be an unwelcome part of the impacts as developers assemble land for larger development, and could reduce the speed of redevelopment.
- There may also be a run-up in prices on residential and commercial stock resulting from this speculation in the area which could lead to pricing out some current residents and businesses. Gentrification could be felt by some residents unless planned for in advance.

No Build

If the No Build condition provides faster travel times between Boston/Cambridge than the other alternatives it will have positive impacts on property values and lease rates in the suburbs north of the project area. These impacts will be very small in dollar value for any individual property owner and will only be felt at significant distances from the site; but there is a benefit to them. However, the elevated highway has a significant negative impact on the properties immediately adjacent to the McGrath corridor. It degrades their character and image in the marketplace and visibility and access. It is difficult to say that the No Build has any significant benefit to employment, sales or revenues, as its impact to the communities to the north of the study area, or in Boston and Cambridge is very small.

Boulevard

This alternative would improve the character of the area for commercial and residential property owners more than other alternatives. It would improve visibility to properties on both sides of the previously elevated section, provides for more of a sense of boulevard along the McGrath corridor as well as Washington Street east of the McGrath corridor, Linwood Street, and Medford Street. This alternative would improve the quality and image of the environment in front of many of the properties in the area. The buffers on the east side of the McGrath corridor would be beneficial for the residential uses, but less so for the commercial, as it would restrict access for businesses fronting on the McGrath corridor to Linwood, Poplar or Washington Streets. Businesses typically would prefer to have access and frontage abutting the major street. The impact of new streets and realignment would be generally good relative to creating parcels for development. This alternative should see an upgrade to businesses and property values in the immediate area, as well as those factors considered in 2.4.1.4 of the Evaluation Matrix. The only other drawback is that slower travel times to and from northern suburbs would have a marginally negative impact on their property values.

U-turn/Rotary Hybrid

The impacts of this alternative would be very similar to the Boulevard Alternative. Some of the reasons that it may provide slightly less benefit relative to the Boulevard Alternative are:

- There is less “boulevard” throughout the focus area due to the increased pavement width associated with the rotary and U-turns.
- A rotary is less desirable in terms of frontage for real estate development due to the higher speed of vehicles and one-way circulation pattern.
- The Somerville Avenue/Medford Street intersection is less attractive for real estate development due to the more complicated during movements from the McGrath mainline.

Linwood Access Road

This alternative would provide some of the same advantages over the No Build as the other alternatives, in that it improves the visibility of parcels along the McGrath corridor. However, this alternative has several significant disadvantages relative to the other two alternatives:

- Washington Street and Somerville Avenue would not flow straight through the intersection in a clearly understandable way, which reduces the apparent connection. The lack of a direct connection degrades access and perceived access for commercial properties both in the immediate district and along the cross streets.
- The alternative has less of a high quality urban character and image, due to the circulating roadway system and potential difficulty accessing properties along the McGrath corridor.
- There is less of a sense of boulevard organization

since the McGrath corridor mainline favors the north/south through volumes. The street and "park/median" would be very wide separating the two sections of Somerville.
- It would not convey an urban feeling as a place to live and do business; it will feel more like a large, elongated rotary.

Community Effects/Environmental Justice

CTPS completed an analysis of the potential impacts each alternative may have on Environmental Justice (EJ) populations. The methodology and summary of findings are provided below, while the summary data are provided in Appendix M.

Title VI of the 1964 Civil Rights Act states that "No person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance." MassDOT's Office of Civil Rights states that:

Title VI of the Civil Rights Acts of 1964 ensures that no person in the United States shall on the grounds of race, color, national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance from the Federal Transit Authority (FTA) and Federal Highway Administration (FHWA) funded programs. Under additional Nondiscrimination statutes age, sex and disability are applicable to Federal programs in addition to programs receiving federal financial assistance due to the Civil Rights Restoration Act of 1987.[3]

The Federal Highway Administration (FHWA) in a memorandum dated October 7, 1999, indicates that the President's Executive Order on Environmental Justice, the U.S. DOT Order, and the FHWA Order further amplify Title VI by providing that "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations."[4]

EJ Neighborhood Definition

For the purpose of this study, an environmental justice transportation analysis zone (TAZ) is defined by the criteria in the Boston MPO's regional equity program (low income and minority population), together with one of the criteria from the Executive Office of Environmental Affairs (EOEA) definition (Limited English proficiency). The detailed criteria are:
- Low income - A low-income population TAZ was defined as having a median household income at or below 80 percent of the Boston MPO median household income. In 2010, the median household income in Boston MPO region is $70,831.
- Minority - A minority population TAZ was defined as having a percentage of minority population (nonwhite and Hispanic) in 2010 greater than 21.4 percent.
- Limited English Proficiency – A limited English language proficiency TAZ was defined as one where 25 percent or more of the residents are classified as lacking proficiency in the English language.

The EJ analysis for this project focused on the 17 neighborhoods in the vicinity of the McGrath corridor: Central Square, Davis Square, East Cambridge, East Medford, East Somerville, Fresh Pond, Harvard Square, Inner Belt/Brickbottom, Kendall/MIT, Medford Hillside, North Cambridge, North Medford, South Medford, Spring Hill, Union Square, West Medford/Medford Sq., and Winter Hill. Among the 179 TAZs that make up these 17 communities, 142 TAZs met one or more of the EJ thresholds described above. The results of the above analyses from the EJ areas near the study area were compared to those from the non-environmental justice areas.

3 http://www.massdot.state.ma.us/OfficeofCivilRights.aspx

4 http://www.fhwa.dot.gov/environment/environmental_justice/facts/ej-10-7.cfm

Performance Measures

Three categories of performance measures were adopted in the CTPS environmental justice analysis:

1. Analyses of accessibility to jobs and needed services, which focused on two measures:
   - The number of employment opportunities in three categories (basic, retail, and service), health care facilities (hospital beds), and higher education facilities, that can be reached within 20 minutes by car, or within 40 minutes by transit.
   - The average travel time to access the above employment opportunities, health care, and higher education institutions.
2. The mobility and congestion analysis compared the average door-to-door travel time for auto and transit trips travelling from and to the study areas between EJ and non-EJ TAZs.
3. The environmental impact analysis examined the volumes of emissions (CO and PM2.5) for roadway VMTs and roadway congested VMTs within the EJ area. Please note that the congested VMT is the average VMTs on the links under the congested condition (links with volume to capacity ratio greater than 0.75), as opposed to the standard VMTs.

Summary of Results

Environmental Impacts

In each build alternative, the EJ TAZs benefited from the reduction in vehicle-miles traveled, CO emissions, and fine particle matter pollution more than the non-EJ population zones.

Mobility

The average travel time (both highway and transit) from/to the TAZs in the study area was reduced in the Build alternatives. Although the travel from/to non-EJ TAZs decreased slightly more than the EJ TAZs, the difference was considered minimal. The absolute difference between percentage change of EJ and non-EJ communities was less than 0.6 %. These differences are statistically insignificant.

Accessibility

The accessibility analysis examined the number of jobs and services, health care facilities, and education institutions available within 20 minutes by car and within 40 minutes by transit, respectively from each neighborhood. It also summarizes the average travel time from EJ and non-EJ neighborhoods to these places.

The results indicated that in all Build alternatives, people will be able to access more jobs and services compared to the No Build condition. The travel time to jobs in the Build alternatives are slightly longer in most of the cases. The non-EJ TAZs will benefit slightly more than EJ TAZs, but again, the t-tests indicate they are statistically insignificant.

The number of available health facilities and education institutions and the average travel time to them remained very close in both the Build alternatives and the No Build conditions for both EJ and non-EJ populations.

Cost Analysis

Understanding the costs associated with different courses of action – both a Build alternative that changes the study area infrastructure and the No Build alternative that makes no new changes to the study area infrastructure – is essential to understanding the overall trade-offs involved in a study recommendation. These costs include not only near-term costs, but all costs incurred with a given course of action over a significant period of time.

Life cycle cost analysis considers all costs over the life of an asset – both capital and operating and maintenance (O&M) – to determine the overall lowest cost alternative. Capital costs are high-value projects incurred either to rehabilitate the transportation infrastructure or to change its configuration, while operating and maintenance costs are lower-value investments incurred to keep a transportation operating in good condition in its base configuration for use by the general public. The cost analysis approach employed here evaluates the costs of initial and future capital expenditures as well as continued maintenance to ensure that the capital investment remains useful to the public.

Order-of-magnitude, life cycle cost estimates were developed for each of the three Grounding McGrath study's Build alternatives, as well as the No Build alternative. It is important to note that each alternative has only been designed to a preliminary stage as part of this study. Estimating the true project cost of each constructed alternative at this stage of design is subject to uncertainty due to the possibility of unknown site conditions, changes in design as the project moves through the environmental permitting and final design process, and other unforeseen factors. To mitigate for this uncertainty in the final project cost, the cost estimates developed for each alternative as part of this analysis carry high "contingency" costs of 25 percent of the total project cost. The addition of "contingency" costs at this stage of project development is standard practice that follows both industry and FHWA recommendations.

As a general comparison, the capital costs for each of the three Build alternatives are higher than the No Build due to the initial costs involved in removing the structures and building the surface roadways. However, the overall life cycle costs of the Build alternatives are lower than the No Build due to the decreased costs of operating and maintaining an at-grade roadway versus elevated structures. Additionally, the estimates show that the life cycle costs associated with the three Build alternatives are very similar to one another. The primary comparison, therefore, is between the No Build alternative and any one of the three Build alternatives.

The costs shown below represent the costs of work that would be executed from the northerly abutment of the Squire's Bridge north along the McGrath corridor to the Lowell Line Bridge. The maintenance of the Squire's Bridge was not included in this analysis as the structure would be maintained in all four alternatives. The costs for work north of the Medford Street/Highland Avenue intersection are provided in the next section. All costs are in 2013 dollars, unless otherwise noted. The expected service life of the highway and structures is 75 years. Details of the cost estimates are provided in Appendix N.

Focus Area of Alternatives

Capital Costs

The capital costs shown in Table 5-5 reflect the initial major improvements being considered under each of the four alternatives. The costs for the McCarthy Viaduct repairs (MassDOT Project Number 605519) initiated in 2012 and the other interim improvements being conducted as part of that project through the MassDOT Accelerated Bridge Program are not included in this analysis because they are considered part of the existing conditions and they are being implemented, irrespective of the alternative selected.

It is assumed that these interim improvements are in place for approximately 10 years, at which time a long-term capital investment is made. The cost comparison of this long-term capital investment is between the No Build alternative, which would entail rehabilitation of the existing structures, and one of the Build alternatives, which would entail demolition of the existing structures and construction of a surface roadway. The capital costs for the No Build alternative include repairs to the substructure of the McCarthy Viaduct that would be needed for the structure to continue being used. For this estimation, it was assumed that those repairs will be conducted in the year 2026, at a cost of $23,250,000 (in 2013 dollars), or $38,713,000 in year of expenditure (2026) dollars.

The capital costs for the three Build alternatives include the cost to demolish the existing McCarthy Viaduct, and construct a new ramp structure between the Squire's Bridge and the Somerville Avenue/Poplar Street/Medford Street intersection with the McGrath corridor, in addition to the roadway improvements. It was assumed that the Build alternatives would be constructed in the year 2026. The capital costs for each alternative are shown in Table 5-5. Note that Table 5-5 shows capital costs expressed in two ways: in current 2013 dollars, and in year of expenditure 2026 dollars. The 2013 costs are what the infrastructure improvement project would cost if it were built today. However, the investment is not needed today; rather, it will be needed in 2026, at which point inflation will have increased costs. Consistent with FHWA guidance, a 4 percent inflation rate for project cost was assumed, which results in the 2026 year of expenditure costs shown in Table 5-5.

Table 5-5: Estimated Capital Costs (2013 and 2026 dollars)

Alternative	Present Day Capital Cost (2013 dollars)	Estimated Year of Expenditure Capital Cost (2026 dollars)
No Build	$23,250,000	$38,713,000
Boulevard	$41,132,800	$68,489,200
U-Turn	$41,797,100	$69,595,300
Access Road	$40,989.100	$68,249,900

Additionally, the following assumptions were made in estimating the capital costs for all four alternatives:

- The estimates do not include the cost of any right-of-way acquisition.
- Cost of adjusting utility structures to grade during pavement operations is included in the contingency.
- The cost for landscaping is based on estimates for loam and seeding, a very basic landscaping treatment. The cost will increase for additional landscaping, to be determined when an alternative advances to a conceptual design phase. These costs would likely be comparable for the three Build Alternatives.

Operating and Maintenance Costs

For the No Build alternative and the Build alternatives discussed in this report, operating and maintenance costs include roadway maintenance costs (pavement rehabilitation, pavement marking replacement) and basic structural upkeep costs (substructure and structural rehabilitation/repair, cleaning/painting structural steel). Table 5-6 provides a list of anticipated operating and maintenance costs and their anticipated year of expenditure.

The costs associated with the three Build alternatives are very similar to one another, not only for capital costs, but also for operating and maintenance costs. Therefore, the primary comparison is between the No Build alternative and the three Build alternatives. For the sake of a simpler comparison, the details of the operating and maintenance costs and corresponding 75 year life cycle costs of the Boulevard Alternative are compared to the No Build in the following tables and figures.

Pavement resurfacing includes costs of new pavement markings, pavement milling and overlay. In contrast, pavement rehabilitation is a more comprehensive improvement that includes full depth pavement reconstruction and sidewalk and curb replacement along the surface roads. The cost for pavement rehabilitation on a structure or ramp is included in the cost for deck replacement or deck overlay. Although the Boulevard Alternative is primarily at-grade, there will continue to be ramp structures to transition from the at-grade section to the Lowell Line and Squire's bridges that will require maintenance. A more detail breakdown of the operating and maintenance costs is shown in Appendix N.

Table 5-6: Operating and Maintenance Costs[5]

Year	No Build		Build	
	Actions	**Cost**	**Actions**	**Cost**
2026	Pavement Resurfacing	$1,419,375		
2046	Pavement Resurfacing, TranSystems Rehab – Option 3	$24,669,375	Pavement Resurfacing	$1,449,375
2051			Clean and Paint Structural Steel, Deck Overlay – Grind & Pave, Deck Joint Rehab/Repair	$3,352,050
2066	Pavement Resurfacing, Tunnel Repairs, Demolition of Structure, Bridge Replacement	$45,116,300	Pavement Resurfacing	$1,449,375
2076			Clean and Paint Structural Steel, Deck Overlay – Grind & Pave, Deck Joint Rehab/Repair, Substructure Rehab/ Repair, Structural Rehab/Repair, Bearing Rehab/Repair.	$9,163,300
2086	Pavement Rehabilitation, Tunnel Repairs, Clean and Paint Structural Steel, Deck Overlay – Grind & Pave, Deck Joint Rehab/Repair	$13,004,845	Pavement Rehabilitation	$3,735,625

Life Cycle Costs

The capital costs and operations and maintenance costs outlined above were then combined to determine the life cycle costs for each alternative. The analysis conducted for this study's alternatives shows that the life span costs of any of the three Build alternatives is lower than the No Build due to reduced costs of maintaining at-grade roadways compared to elevated structures.

Table 5-7: Total 75 Year Costs (in 2013 dollars)

Alternative	Capital Cost in 2013 dollars	O&M Cost in 2013 dollars	Total Cost Over 75 Years in 2013 dollars
No Build	$23,250,000	$84,209,900	$107,459,900
Boulevard	$41,132,800	$30,583,500	$71,716,300
U-turn/Rotary	$41,797,100	$30,387,900	$72,185,000
Linwood Access Road	$40,989,100	$30,583,500	$71,572,600

Figure 5-15 provides a summary of the when the major expenditures in Table 5-6 are expected to occur. Figure 5-16 shows the cumulative amount expected to be spent over the 75 year life of the alternative.

5 No Build Cost Estimate is based on TranSystems cost estimate for Option 3, plus 25 percent contingency, and is included in Appendix N

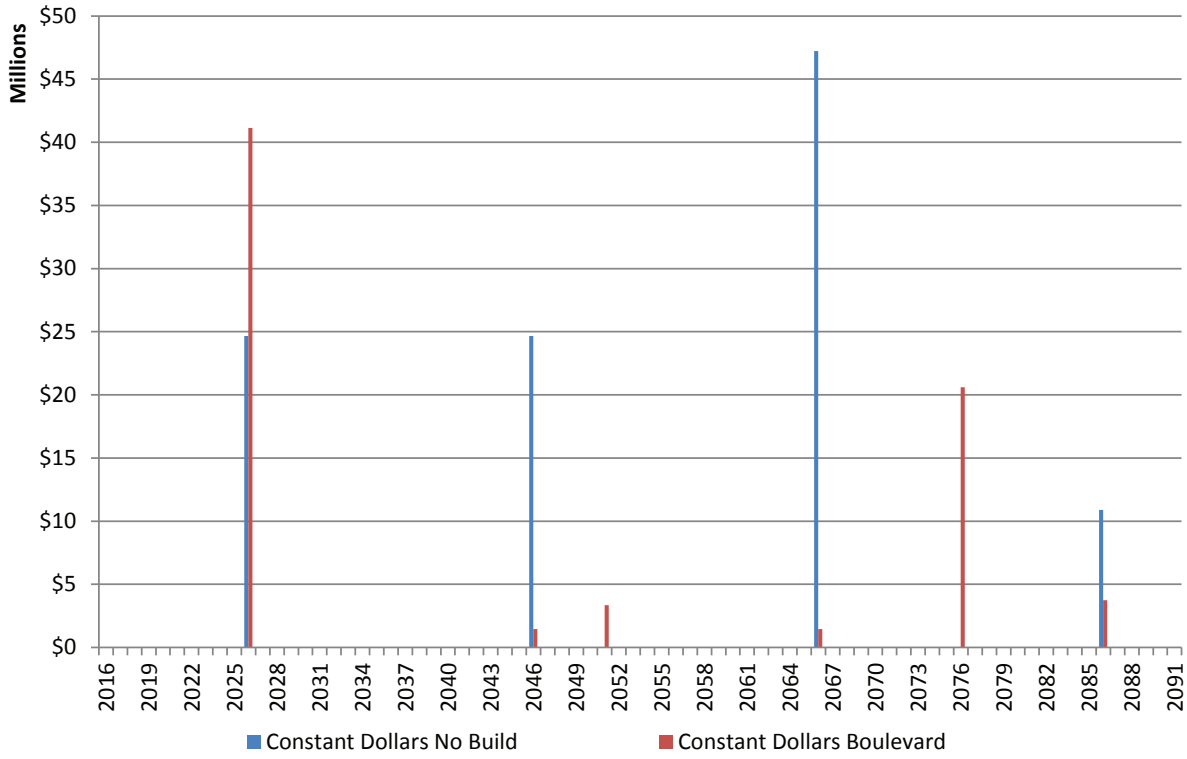


Figure 5-15: 75 Year Capital, Operating, and Maintenance Expenditures (in 2013 dollars)

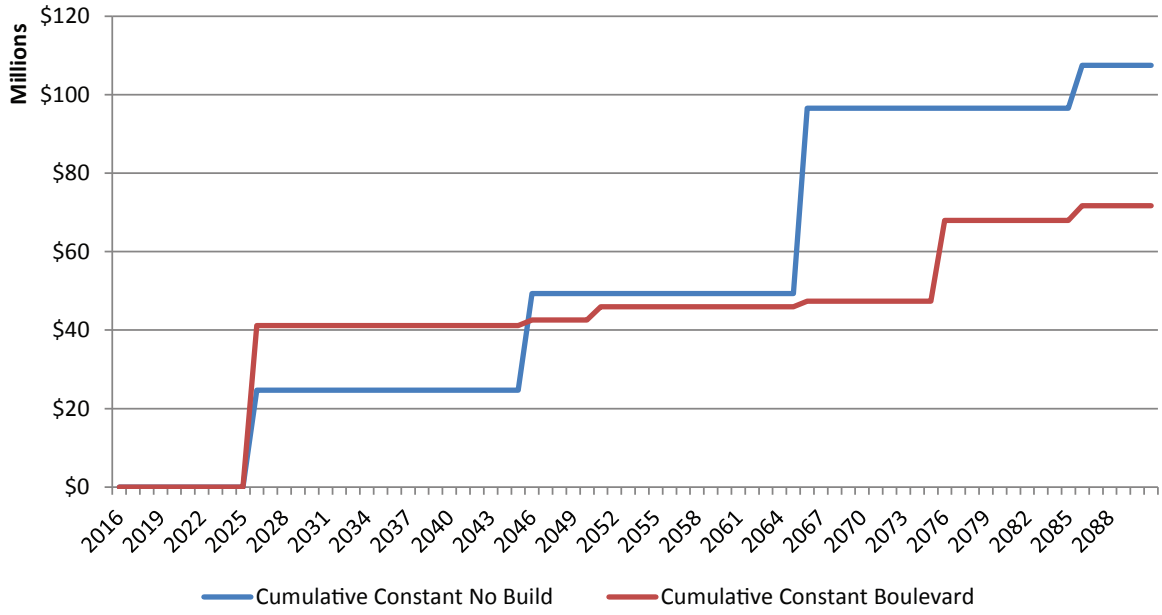


Figure 5-16: Cumulative Cost of the Alternatives over 75 Years

North of Lowell Line Bridge

The project team also prepared a cost estimate for two alternatives for highway work north of the Lowell Line Bridge (see Chapter 4). The first alternative provides a bicycle lane with parking. The project team estimated the cost of the first alternative at approximately $545,100. The second alternative included a cycle track north of the Lowell Line Bridge. The project team estimated the cost of the second alternative at approximately $1,441,600. These estimates are in 2013 dollars and do not include the cost of design.

Summary of Findings

Evaluation Matrix

The Evaluation Matrix in Table 5-1 was prepared as a tool for the Grounding McGrath study and the community to compare the developed alternatives and the No Build conditions. The Evaluation Matrix does not establish any preference or weighting of the importance of one objective to another. These preferences are part of the community and Working Group discussions.

The Evaluation Matrix ranks each of the proposed alternatives based on the categories outlined under each goal. All of the proposed scenarios -- Boulevard, Access Road, Hybrid U-turn/ Rotary and Boulevard & Inner Belt Road, and the 2035 No Build -- were quantitatively scored based on their ability to meet each of the set criteria. Using these values, a qualitative type analysis was executed to compare each of the scenarios with a 2035 No Build scenario. The qualitative analysis provided a visual communication of the quantitative data garnered by each ranking and demonstrates the degree to which each scenario would be more or less beneficial compared to projected 2035 McGrath corridor No Build conditions.

The analysis showed that all grounded alternatives provide benefits based on the criteria evaluated. There are key differences between the alternatives, primarily related to traffic patterns and connections enabled by each alternative. For example, the Boulevard Alternative provides the most direct connections, but prohibits left-turns from the McGrath corridor to Washington Street. The Linwood Access Road Alternative provides some of the best traffic operations of the three alternatives analyzed, but at the expense of longer blocks and fewer direct connections.

As a result of the analysis, the study provides several broad conclusions:

- Build alternatives show an improvement over the No Build scenario.
- Build alternatives have similarities in achieving the project's goals.
- Build alternatives have challenges and traffic implications.
- Build alternatives improve community character and provide environmental, public health and Environmental Justice benefits.
- Build alternatives provide new real estate development opportunities.
- Build alternatives have lower 75-year life-cycle costs for the focus area than the No Build alternative.

Lastly, for each of the alternatives, the Grounding McGrath study identified traffic, operational, and other potential issues that have not been resolved. For example, a lack of sufficient traffic dispersion to other streets in the network, and the resulting capacity issues at several intersections are critical to understanding the overall context of each alternative as they are reviewed and advanced for further study.

MassDOT District 4 Short-Term Improvements

As a result of stakeholder involvement in the Grounding McGrath study, MassDOT District 4 began working with the City of Somerville and other stakeholders to make some short-term multimodal access and circulation changes through the existing construction contract for repairs to the McCarthy Viaduct. The proposed improvements were developed as a result of positive feedback on some of the potential alternatives identified through Grounding McGrath, such as improved connections between Somerville Avenue and the McGrath corridor. The alternatives were developed and analyzed separately from this study, and are summarized below for informational purposes.

The proposed short-term improvements include the closure of the southbound ramp north of the intersection of Somerville Avenue/Medford Street. This will require southbound vehicles destined to Somerville Avenue to exit McGrath at Washington Street and require an increase in green signal time for the McGrath off-ramp approach to Washington Street. In order to handle the vehicular demand between Washington Street and Somerville Avenue, it may be necessary to create two travel lanes along Medford Street, which would necessitate the elimination of some parking. There would also be additional geometric and signal equipment modifications.

A second aspect of this work is a proposed "punch-through" under the McCarthy Viaduct to allow direct access to the McGrath corridor (northbound) from Somerville Avenue/Medford Street. This proposal eliminates the need for the traffic from Somerville Avenue/Medford Street destined to McGrath northbound to use the tunnel under the McCarthy Viaduct to access the northbound ramps at Washington Street The punch through allows for traffic eastbound from Somerville Avenue, and northbound from Medford Street, to cross under the viaduct at Somerville Avenue and connect with the northbound McGrath traffic at-grade. It creates an opportunity for enhanced pedestrian and bicycle connections and accommodations, and the ability to upgrade signal operations. It is also expected to reduce congestion at Washington Street.

MassDOT District 4's short-term improvements for pedestrian crossings and circulation changes associated with the McCarthy Viaduct interim repairs provide an opportunity to assess new connections. The result of these potential changes can and should be incorporated in the project development for the future of the McGrath corridor.

Health Impact Assessment

The Commonwealth's Health Impact Assessment (HIA), led by the Department of Public Health (DPH), evaluated air quality, noise, safety, mobility, land use, pedestrian and bicycle friendliness of the alternatives. Factors such as projected housing and employment growth, economic development, mode shift as a result of the GLX, were incorporated in the assessment. Health factors such as asthma, hospitalization, obesity, diabetes, injury and fatality data were also considered.

The Department of Public Health's (DPH) Health Impact Assessment (HIA) of the Massachusetts Department of Transportation (MassDOT) Grounding McGrath Study, April 2013, (HIA report) supports an at-grade alternative for McGrath and provides the following conclusions:

- All Build alternatives (for the forecast year 2035), including the No Build, result in significant reductions in traffic-related air pollution largely attributed to advancements in vehicle emission standards and technologies.
- Future assessment of health impacts and benefits of proposed Build alternatives should be conducted once more robust project-specific information and transportation data become available.
- De-elevation of the highway structure is anticipated to result in an increase in ground-level exposure to traffic-related air pollutant emissions.
- Mitigation measures (locating sidewalks and bike paths further away from the roadway, installing barriers, planting trees) should be explored where possible to reduce exposure to traffic related air pollutants.

Feedback from the Working Group

Through the study's public outreach process - specifically Working Group meetings held February 13, 2013 and April 25, 2013 - preference for the criteria related to livability, multimodal transportation, connectivity, community development, and placemaking were expressed, and were also given priority by Working Group members in evaluating their preference for a long-term alternative. The Working Group expressed support for MassDOT to recommend a Boulevard Alternative at a public meeting. Some members of the Working Group expressed interest in pursuing a narrower Boulevard Alternative in subsequent stages, particularly once there is new traffic data from the potential District 4 short-term improvements described above.

CHAPTER 6: RECOMMENDATIONS

Introduction

The purpose of the Grounding McGrath study is to identify alternatives that improve the McGrath corridor and provide a multi-modal transportation corridor that provides effective access for all users, while balancing regional mobility with neighborhood livability. The study included a thorough alternatives analysis framed by a comprehensive civic engagement process with the MassDOT-appointed Working Group and the public in general. The recommendations summarized in this chapter have been selected primarily because they best address the issues identified in the corridor when assessed through the lens of specific goals, objectives and evaluation criteria that were developed through input from both the Working Group and the general public.

Formally, this report marks the end of the planning process, and the beginning of the project initiation, environmental permitting, and project development stages. This report identifies which components of the planning study's recommendations need further analysis or public input, and which alternatives can reasonably be promoted or advanced for more detailed evaluation, permitting or design as part of the project development process. Public involvement will continue as these recommended improvements are brought through the stages of permitting, design, and construction.

Planning Context

The Grounding McGrath study has been conducted in the context of transportation policy and planning principles that are significantly different from those that were in place when the McCarthy Viaduct and other components of the McGrath corridor were built. The planning environment for infrastructure in Massachusetts and around the country has changed, in terms of evolving policy positions and in local and regional priorities. The recommendations for the Grounding McGrath study are not determined strictly by how much traffic can be moved, and are informed by:

- MassDOT's GreenDOT policy, which includes the MassDOT goal of tripling the travel mode share by bicycle, transit, and walking.[1]
- Federal regulations under the Moving Ahead for Progress in the 21st Century (MAP-21) that increase the emphasis on non-auto users.
- MassDOT's Complete Streets policy which requires balancing the use of the public right-of-way for all transportation modes.
- The Massachusetts Healthy Transportation Compact and MassDOT's Healthy Transportation Policy Directive, which requires that all MassDOT projects not only accommodate, but actively promote healthy transportation modes.
- The Accelerated Bridge Program's emphasis on long-term maintenance costs, and consideration of removing, rather than rebuilding, structures that are not completely necessary. MassDOT is reviewing elimination of such structures as the Casey Overpass in the Jamaica Plain neighborhood of Boston; underpass structures along the Rutherford Avenue corridor in the Sullivan Square neighborhood of Boston; and the Route 79 viaduct in Fall River.

All of these policies reflect the fact that roadways are part of the infrastructure that must serve all users, while being an integral part of their surrounding neighborhoods. Providing access for all modes and travelers, considering vulnerable roadway users, enhancing transportation choices, fostering community connectivity and economic development, and ensuring the public health of adjoining residents are important considerations that are recognized through the policies and initiatives described above.

As described in Chapter 1, Grounding McGrath was conducted within the evolving local and regional environment around the McGrath corridor. The City of Somerville has undertaken significant planning efforts to enhance economic development and improve access for the Inner Belt, Brickbottom and Union Square areas. The City of Cambridge is advancing plans for the redevelopment of NorthPoint, which includes a set of associated transportation improvements. The Green Line extension (GLX) will provide new transit service to the corridor, as well as potential roadway changes. The neighborhoods surrounding the corridor are growing as well, with population growing faster in the McGrath corridor than in the surrounding towns.

1 http://transportation.blog.state.ma.us/blog/2012/10/massdot-goal-triple-travel-by-bicycle-transit-walking.html

Recommended Long-Term Corridor Alternative

It is within the context described above that MassDOT recommends moving forward with the Boulevard Alternative (see Figure 6-1 and Figure 6-2), which would provide six general travel lanes (three in each direction) to accommodate northbound and southbound traffic. This alternative would provide the following benefits:

- Provide a Complete Streets design for the McGrath corridor by incorporating access for all modes and for users of a diverse range of ages and abilities.
- Improve traffic operations at seven of fifteen intersections compared to the No Build due to refined signal timing and reduced volumes.
- Reduce roadway width and congestion through management of circulation and turning movements.
- Improve multi-modal access to Union Square and Brickbottom via the McGrath corridor, Somerville Avenue, and Poplar Street.
- Provide at-grade intersections that are more intuitive for wayfinding.
- Create enhanced pedestrian access across the corridor.
- Allow the reclamation of the right-of-way for other uses.
- Provide for urban design and community character improvements.
- Provide an opportunity for compliance with the Americans with Disabilities Act of 1990 and the Massachusetts Architectural Access Board by being rigorously designed to current accessibility and mobility standards and regulations.

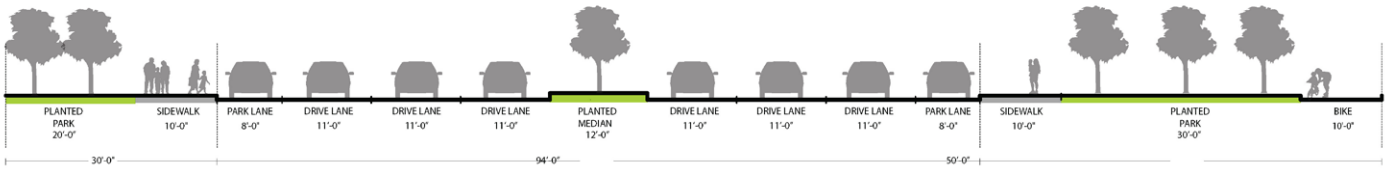
MassDOT and the project team presented this recommended alternative at a public meeting on May 15, 2013. Those in attendance were generally supportive of MassDOT's efforts to remove the existing barrier created by an elevated highway and incorporate transit and non-motorized modes of travel. However, many Working Group members and other attendees also voiced comments, concerns, and preferences regarding the preferred alternative. MassDOT recognizes these concerns, and takes this feedback from the Working Group and the community very seriously. The following are the principal issues raised about the preferred alternative, and responses to those issues:

Roadway Cross-Section

- Public Comments. A preference for further reduction of vehicular capacity, and an exploration of a Boulevard option with four travel lanes (two in each direction). Many participants expressed this preference, and it is the comment that would have the greatest effect on the overall design and function of the preferred alternative, and is discussed further below.
- MassDOT Response. It is understandable that the Grounding McGrath study participants favor an alternative that emphasizes minimizing local impacts. MassDOT, however, must also consider the impacts of the corridor design on roadway users in all modes. While MassDOT feels that the Six-Lane Boulevard Alternative was developed, refined, and analyzed as a design approach that appropriately balances regional mobility with multi-modal accessibility and neighborhood livability, MassDOT is willing to give consideration to a four-lane design for the McGrath corridor, as discussed further below. A four-lane design may result in reduced motor vehicle demand and volumes in the corridor; however, this would be due to increased congestion and delay, which would also be experienced by residents of neighborhoods abutting the corridor.

Functional Classification of the McGrath Corridor

- Public Comments. A preference for creating a more "livable community" by designing a local roadway, rather than an arterial.
- MassDOT Response. MassDOT strongly supports a McGrath corridor design that helps to create a livable community in the area, and multi-modal transportation corridors both along the McGrath corridor and Washington Street. Relative to the question of a local roadway versus an arterial roadway, these are technical "functional classes" of roadway. An arterial is a higher-volume roadway that is used largely for longer trips, while a local roadway is the "lowest" class of roadway, and is used principally for access to and from adjacent land uses. The McGrath corridor is currently a principal arterial, the "highest" class of roadway aside from interstate highways. It currently serves important regional connections for Medford, Somerville, Cambridge,



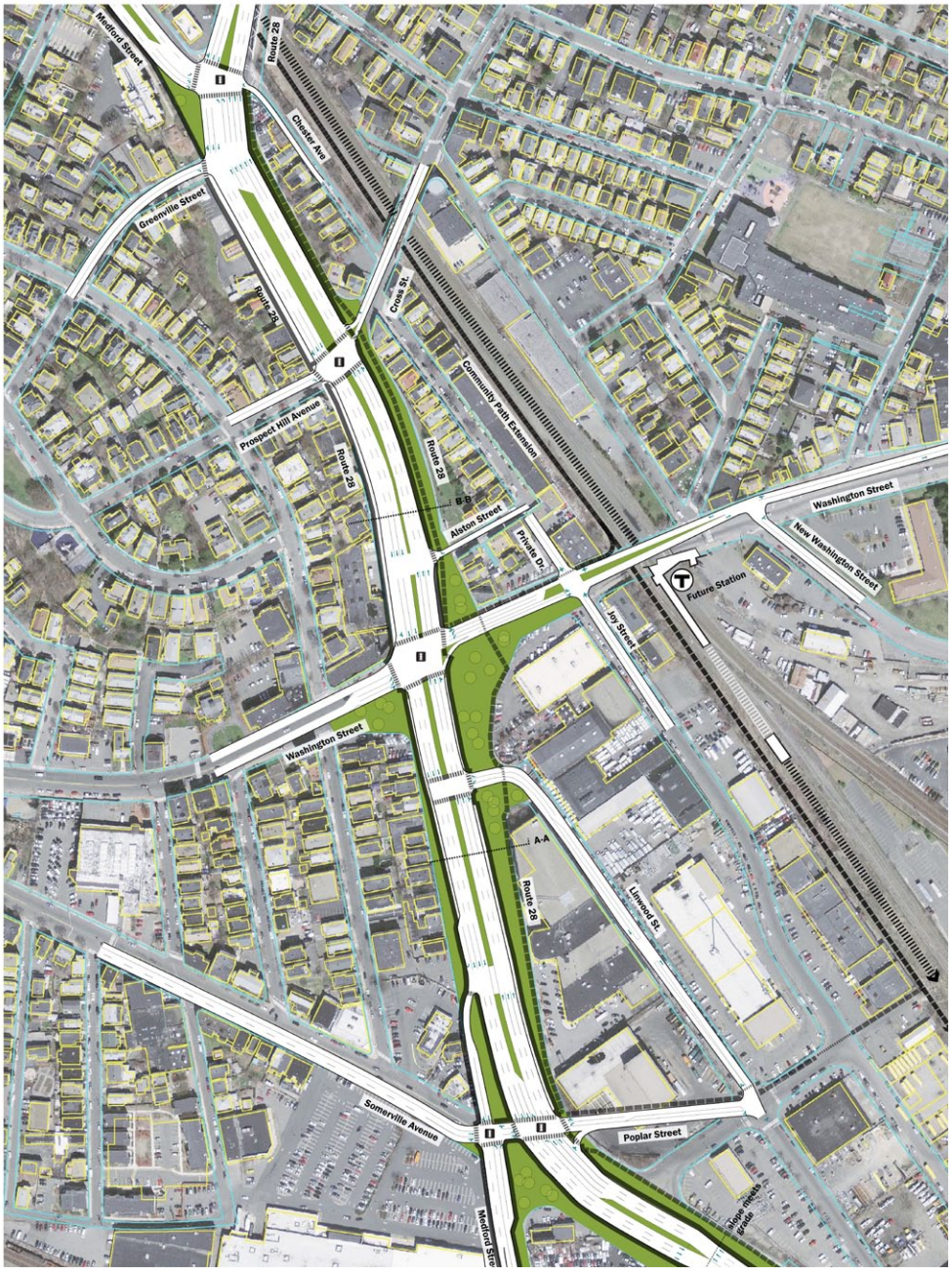
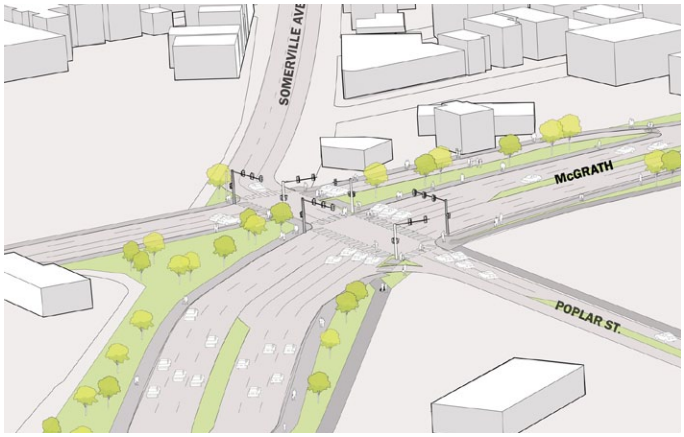
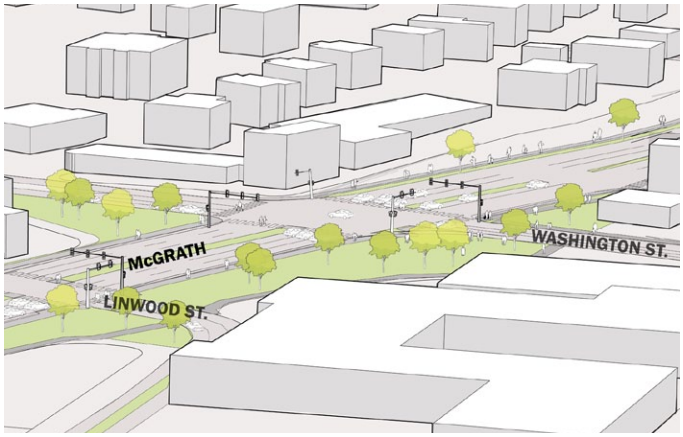


Figure 6-1 : Boulevard Recommended Alternative

Somerville Avenue Intersection



Washington Street Intersection



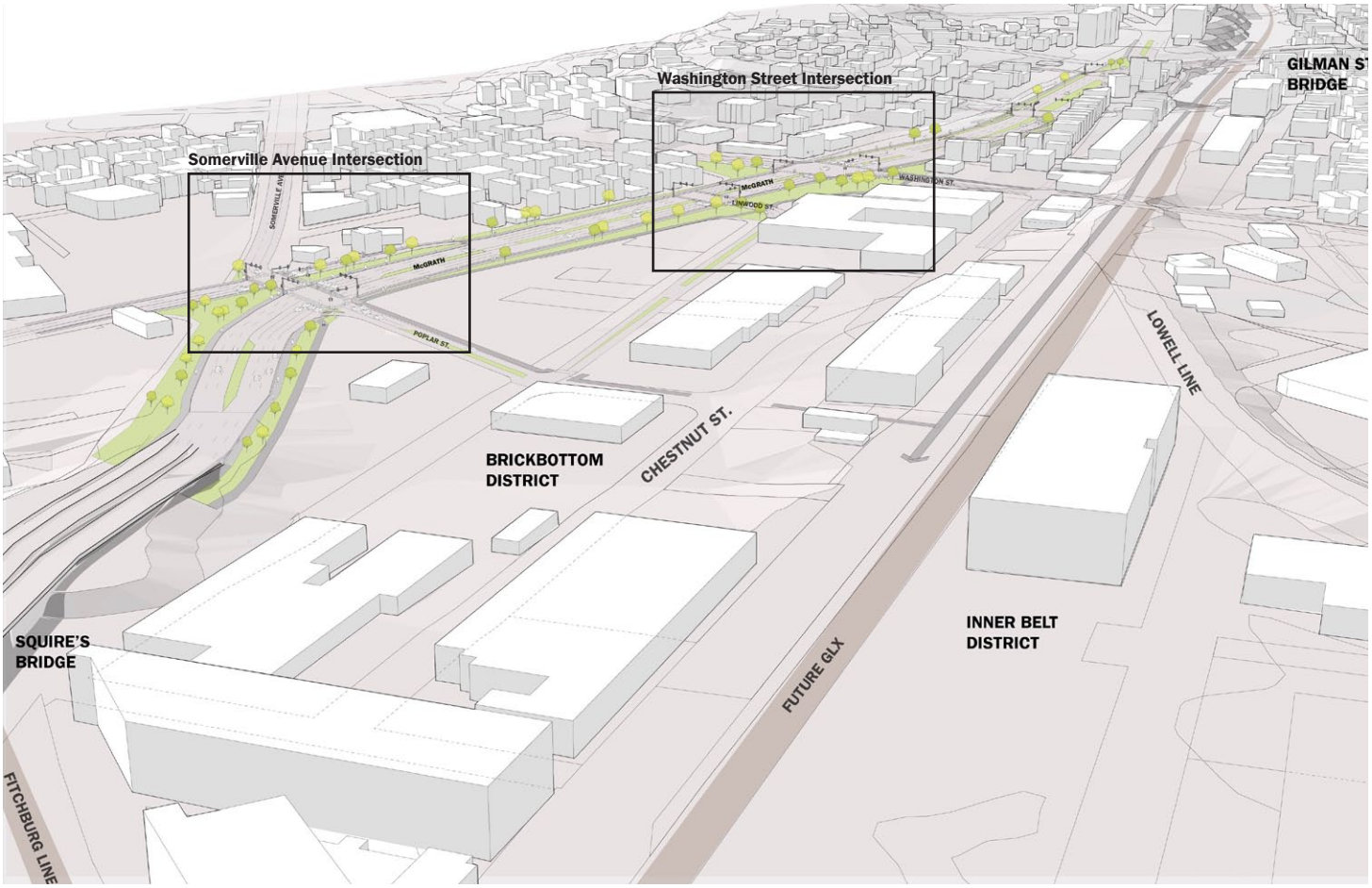


Figure 6-2: Boulevard Alternative Renderings

and Boston, and MassDOT believes it should continue to do so, even in a lower-volume, lower-speed, and more neighborhood-friendly at-grade configuration.

Multi-Modal Facility Design

- Public Comments. A desire for more clearly-defined pedestrian and bicycle facilities.
- MassDOT Response. Each Build alternative includes comprehensive and thorough consideration and accommodation of pedestrian and bicycle facilities. Such facilities are provided in the designs of all the Build alternatives. The designs of the Boulevard Alternative are appropriate for the purposes of a planning study, but they are still conceptual. The level of definition of accommodation for all modes is still fairly general, and will become more clearly defined as the corridor design advances through an open and public process.

Circulation and Turn Restrictions

- Public Comments. Concerns about the impact of circulation management and turn restrictions on local access.
- MassDOT Response. Turn lanes require widening a roadway. They also reduce operational efficiency by requiring the addition of more phases to a traffic signal cycle, which increases congestion. The preliminary concept for the Boulevard Alternative proposes the elimination of northbound and southbound left turns at Washington Street; these turning movements have relatively low volumes, and the connections that they provide can also be satisfied at adjacent intersections (via northbound left turns at Somerville Avenue and southbound left turns at Poplar Street). Including left turns from McGrath at Washington Street would also reduce the operational efficiency of the intersection and the corridor in a way that would make a four-lane boulevard cross-section even harder to achieve. Even though these turn restrictions would make local access more circuitous for neighborhood residents, it is more likely to help achieve the goals of a narrower, more livable corridor.

Based on the study analysis and the feedback received at the May 15, 2013 public meeting, MassDOT recommends advancing the Six-Lane Boulevard Alternative into the environmental review process. MassDOT also recommends consideration of a Four-Lane Boulevard/Road Diet sub-option that further reduces roadway scale. This sub-option would require additional analysis through the environmental process, comparable to what was completed for the six-lane option for the Grounding McGrath study. The environmental review and project development process will be conducted in the context of the opportunities and challenges discussed below.

Recommended Long-Term Corridor Alternative – Opportunities and Challenges

Advancing both the Boulevard Alternative developed in this planning study and a four-lane sub-option with reduced roadway dimensions to the project development stage requires that the following opportunities and challenges be considered.

All at-grade alternatives result in some diversion of trips from the McGrath corridor. Due to the change in vehicle capacity along the McGrath corridor and the resulting reduction in congested travel speed, the CTPS regional travel demand model indicates that some vehicles may seek alternate routes in order to travel on roads with more available capacity. While the regional travel demand model adequately takes into account some of the expected future changes – such as the vehicle fleet-mix, technology changes, and new transit services – there may be unexpected factors that could serve to reduce the expected volumes using the McGrath corridor and the surrounding roadways.

For example, the Inner Belt and Brickbottom districts (IBBB) in Somerville, east of the McGrath corridor and south of Washington Street, have the greatest potential for future development that would increase population and employment in the corridor. Once this area has a greater mix of uses, internal capture of trips could increase at a rate greater than what is reflected in the regional travel demand model. An aggressive Transportation Demand Management (TDM) program to reduce vehicular trips associated with new development in the IBBB and NorthPoint districts could result in fewer automobile trips than what the regional travel demand model is able to project with current assumptions in place. In addition, non-motorized transportation improvements that are implemented in the future, but not yet included in the Boston MPO regional plans, could

result in further mode shifts from automobile trips to other means of travel.

Moreover, there are examples of other urban viaduct removal and expressway downgrading projects around the country that have demonstrated that a certain amount of traffic reduction can be achieved through peak period spreading, mode shift to transit use, rideshare options, and an increase in pedestrian and bicycle trips. For example, San Francisco's elevated Central Freeway carried 100,000 cars per day, while the Octavia Boulevard that replaced it carries 45,000 with less than 3% shifting to transit. In Portland, the Tom McCall Waterfront Park replaced the Harbor Drive Freeway, leading to 9.6% fewer vehicle trips on roads and bridges near the former ground-level highway.[2] More generally, a study of road capacity reductions at over 100 locations internationally found that motorized traffic decreased by about 25%, even incorporating a control for traffic on parallel routes.[3]

Other challenges to be addressed in the design and project development for the Boulevard Alternative include:

- Traffic diversion could cause impacts on local streets and neighborhoods.
- Prohibition of left-turns from the McGrath corridor to Washington Street would constrain connections. However, these turns are relatively low in volume, and allowing them would result in a wider intersection for pedestrian crossings and would worsen operational efficiency and congestion.
- High east and west traffic volumes on Washington Street, including left-turns onto the McGrath corridor, will need to be accommodated.
- Roadway delay and congestion as northbound queues on the McGrath corridor may exceed block lengths due to the proximity of the Washington Street and Linwood Street intersections.
- Minimal queue storage between signals and high demand for left-turns at the McGrath/Somerville Avenue/Medford Street/Poplar Street intersection area may cause delay and congestion.
- The fixed width of the Squire's Bridge may constrain the extension of bicycle and pedestrian accommodations along the McGrath corridor to the south.

2 Seattle Urban Mobility Plan, Case Studies in Urban Freeway Removal, 2008, http://www.seattle.gov/transportation/docs/ump/06%20SEATTLE%20Case%20studies%20in%20urban%20freeway%20removal.pdf

3 P. Goodwin, C. Haas-Klua, and S. Cairns, Evidence on the effects of road capacity reduction on traffic levels, Journal of Transportation Engineering + Control Vol. 39, No. 6, 1998, pp. 348-354, as cited in R. Cevero, Freeway Deconstruction and Urban Regeneration in the United States, paper prepared for the International Symposium for the 1st Anniversary of the Cheonggyecheon Restoration, 2006 (http://www.uctc.net/papers/763.pdf)

Recommended Long-Term Corridor Alternative – Implementation Plan

The following is a summary of the short-term, medium-term, and long-term steps to be taken in order to pursue implementation of the Boulevard Alternative for the McGrath corridor.

	Actions	Primary Responsibility	Supporting Responsibility
	Immediate Actions		
I1	Initiate the project development process by submitting Project Needs and Initiation Forms	City of Somerville	MassDOT
I2	Determine level of State and Federal environmental review and permitting necessary to proceed into project development	MassDOT	
I3	Work with the Boston Metropolitan Planning Organization (MPO) to include the project in the next update of the Regional Transportation Plan (RTP)	City of Somerville	
I4	Collect traffic, bicycle and pedestrian data and conduct analyses to assess circulation changes and opportunities resulting from the interim improvements proposed by MassDOT District 4 as part of the ongoing structural repair work	MassDOT	
	Medium-Term Actions		
M1	Conduct and complete environmental permitting and preliminary engineering process that should include, but not be limited to, the following: • Examination of the implications of traffic diversions that could occur on side streets, adjacent neighborhoods, and the regional roadway network including Rutherford Avenue • Clarify and integrate plans for the Brickbottom, Inner Belt, and Union Square areas of Somerville and NorthPoint in Cambridge • Continue coordination with the Green Line Extension (GLX) project to clarify improvements and ensure proper connectivity • Ensure that accommodations for local bus route stops are considered and incorporated as part of the design options	MassDOT	City of Somerville, Stakeholders, General Public MBTA MBTA

	Actions	Primary Responsibility	Supporting Responsibility
	• Develop potential design refinements at Washington Street based on potential for trip diversion with new IBBB connections (e.g. additional eastbound/westbound lanes; exclusive, channelized right-turn lanes) • Coordinate with Federal Highway Administration (FHWA) on implications of changing the McGrath corridor as part of the National Highway System (NHS) • Incorporate elements of the Health Impact Assessment recommendations • Ensure proper connections to Somerville Community Path to the north and south • Develop and integrate a corridor-management plan for curb cuts • Examine potential utility upgrades (e.g. underground, relocation, fiber optic, etc. • Select a preferred Boulevard Alternative design option	MassDOT	Stakeholders
M2	Implement an aggressive Travel Demand Management (TDM) program aimed at reducing single-occupant vehicular trips along the McGrath corridor as well as overall trips generated, particularly in areas targeted for future development.	City of Somerville	MassRIDES
	Long-Term		
L1	Complete engineering, design, and permitting	MassDOT	Stakeholders
L2	Coordinate with the Boston Metropolitan Planning Organization (MPO) to secure construction funding through the regional Transportation Improvement Program (TIP)	City of Somerville	Boston MPO

McGrath Corridor Interim Improvements

There are a number of short-term and medium-term recommendations related to physical improvements and policy implementation that should be pursued either independent of the long-term Boulevard Alternative, or else are important interim measures that should be put in place in advance of the Boulevard Alternative and Four-Lane sub-option. There are also a number of short-term and medium-term actions that should be taken in pursuit of the Boulevard Alternative through the environmental permitting, project development, and funding processes.

	Actions	Primary Responsibility	Supporting Responsibility
C1	Improved pedestrian crossings with new crosswalks, signage and signal timing at the following intersections with McGrath Highway • Medford Street/Highland Avenue • Washington Street • Medford Street/Somerville Avenue (west of the McGrath corridor) • Medford Street/Somerville Avenue/Poplar Street (east of the McGrath corridor)	MassDOT	City of Somerville, Stakeholders
U1	Complete McCarthy Viaduct Interim Repairs	MassDOT	City of Somerville, Stakeholders
U2	Continue to Advance Design of Somerville Avenue 'Punch-Through' to McGrath Highway Northbound, and McGrath Southbound Off-Ramp to Somerville Avenue Closure	MassDOT	City of Somerville, Stakeholders
I1	Improve the roadway cross-section, north of the Lowell Line bridge, by adding on-street parking and/or bicycle facilities (Complete Streets approach) • Examine removal of the Otis Street pedestrian bridge		
I2	Explore the feasibility of changes in lane configurations at the intersection of Highland Avenue/Medford Street at the McGrath corridor	MassDOT	City of Somerville, Stakeholders
I3	Promote safe routes of travel for pedestrians and bicycles within the McGrath corridor, such as providing a "best routes" map	City of Somerville	Stakeholders

MassDOT Project Development and Design Process

Transportation decision-making is complex and can be influenced by legislative mandates, environmental regulations, financial limitations, agency programmatic commitments, and partnering opportunities. Decision-makers and reviewing agencies, when consulted early and often throughout the project development process, can ensure that all participants understand the potential impact these factors may have on project implementation. Project development is the process that takes a transportation improvement from conception through construction.

The MassDOT Highway Division has developed a comprehensive project development process which is contained in Chapter 2 of the MassDOT Highway Division's Project Development and Design Guide. The eight-step process covers a range of activities extending from identification of a project need, through completion of a set of finished contract plans, to construction of the project. The sequence of decisions made through the project development process progressively narrows the project focus, while developing greater design details, and ultimately leads to a project that addresses the identified needs in the most cost-effective and publicly acceptable way. The Grounding McGrath study has been structured to meet the first two steps of the project development process: 1) Needs Identification, and 2) Planning. The more-detailed descriptions provided below are focused on the process for a roadway project, but the same basic process will need to be followed for non-roadway projects as well.

1. Needs Identification
For each of the locations at which an improvement is to be implemented, MassDOT leads an effort to define the problem, establishes project goals and objectives, and defines the scope of the planning needed for implementation. To that end, it has to complete a Project Need Form (PNF), which states in general terms the deficiencies or needs related to the transportation facility or location. The PNF documents the problems and explains why corrective action is needed. For this study, the information defining the need for the project will be drawn primarily, perhaps exclusively, from the present report. Also, at this point in the process, MassDOT meets with potential participants, such as the Metropolitan Planning Organization (MPO) and community members, to allow for an informal review of the project.

The PNF is reviewed by the MassDOT Highway Division district office whose jurisdiction includes the location of the proposed project. MassDOT also sends the PNF to the MPO, for informational purposes. The outcome of this step determines whether the project requires further planning, whether it is already well supported by prior planning studies, and, therefore, whether it is ready to move forward into the design phase, or whether it should be dismissed from further consideration.

2. Planning
This phase will likely not be required for the implementation of the improvements proposed in this planning study, as this planning report should constitute the outcome of this step. However, in general, the purpose of this implementation step is for the project proponent to identify issues, impacts, and approvals that may need to be obtained, so that the subsequent design and permitting processes are understood.

The level of planning needed will vary widely, based on the complexity of the project. Typical tasks include: define the existing context, confirm the project need, establish goals and objectives, initiate public outreach, define the project, collect data, develop and analyze alternatives, make recommendations, and provide report documentation. Likely outcomes include consensus on the project definition to enable it to move forward into environmental documentation (if needed) and design, or a recommendation to delay the project or dismiss it from further consideration.

3. Project Initiation
At this point in the process, the proponent, MassDOT Highway Division, fills out a Project Initiation Form (PIF) for each improvement, which is reviewed by its Project Review Committee (PRC) and the MPO. The PRC is composed of the Chief Engineer, each District Highway Director, and representatives of the Project Management, Environmental, Planning, Right-of-Way, Traffic, and Bridge departments, and the MassDOT Federal Aid Program Office (FAPO). The PIF documents the project type and description, summarizes the project planning process, identifies likely funding and project management responsibility, and defines a plan for interagency and

public participation. First the PRC reviews and evaluates the proposed project based on the MassDOT's statewide priorities and criteria. If the result is positive, MassDOT Highway Division moves the project forward to the design phase, and to programming review by the MPO. The PRC may provide a Project Management Plan to define roles and responsibilities for subsequent steps. The MPO review includes project evaluation based on the MPO's regional priorities and criteria. The MPO may assign project evaluation criteria score, a Transportation Improvement Program (TIP) year, a tentative project category, and a tentative funding category.

4. Environmental Permitting, Design, and Right-of-Way Process

This step has four distinct but closely integrated elements: Public Outreach, Environmental Documentation and Permitting (if required), Design, and Right-of-Way Acquisition (if required). The outcome of this step is a fully designed and permitted project ready for construction. The sections below provide more detailed information on the four elements of this step of the project development process.

Public Outreach

Continued public outreach in the design and environmental process is essential to maintain varying levels of public support for the project and to seek meaningful input on the design elements. The public outreach is often in the form of required public hearings (conducted at the 25-percent and 100-percent design milestones), but can also include less formal dialogues with those interested in and affected by a proposed project.

Environmental Documentation and Permitting

The project proponent, in coordination with the Environmental Services section of the MassDOT Highway Division, will be responsible for identifying and complying with all applicable federal, state, and local environmental laws and requirements. This includes determining the appropriate project category for both the Massachusetts Environmental Policy Act (MEPA) and the National Environmental Policy Act (NEPA). Environmental documentation and permitting is often completed in conjunction with the Preliminary Design phase described below.

Design

There are three major phases of design. The first is Preliminary Design, which is also referred to as the 25-percent submission. The major components of this phase include a full survey of the project area, preparation of base plans, development of basic geometric layout, development of preliminary cost estimates, and submission of a functional design report. Preliminary Design, although not required to, is often completed in conjunction with the Environmental Documentation and Permitting. The next phase is Final Design, which is also referred to as the 75-percent and 100-percent submission. The major components of this phase include preparation of a subsurface exploratory plan (if required), coordination of utility relocations, development of traffic management plans through construction zones, development of final cost estimates, and refinement and finalization of the construction plans. Once Final Design is complete, a full set of Plans, Specifications, and Estimates (PS&E) is developed for the project.

Right-of-Way Acquisition

A separate set of Right-of-Way plans are required for any project that requires land acquisition or easements. The plans must identify the existing and proposed layout lines, easements, property lines, names of property owners, and the dimensions and areas of estimated takings and easements.

5. Programming (Identification of Funding)

Programming, which typically begins during the design phase, can actually occur at any time during the process, from planning to design. In this step, which is distinct from project initiation, the proponent requests that the MPO place the project in the region's Transportation Improvement Program (TIP). The proponent requesting the project's listing on the TIP can be the community or it can be one of the MPO member agencies (the Regional Planning Agency, MassDOT, and the Regional Transit Authority). The MPO then considers the project in terms of state and regional needs, funding availability, project readiness, evaluation criteria, and compliance with the Regional Transportation Plan and decides whether to place it in the Draft TIP for public review and then in the Final TIP. A project does not have to be fully designed in order for the MPO to program it in the TIP, but generally a project has reached 75-percent design to be programmed in the year-one element of the TIP.

6. Procurement
Following project design and programming of a highway project, the MassDOT Highway Division publishes a request for proposals, which is also often referred to as being 'advertised' for construction. MassDOT then reviews the bids, and awards the contract to the qualified bidder with the lowest bid.

7. Construction
After a construction contract is awarded, MassDOT Highway Division and the contractor develop a public participation plan and a traffic management plan for the construction process.

8. Project Assessment
The purpose of this step is to receive constituents' comments on the project development process and the project's design elements. MassDOT Highway Division can apply what is learned in this process to future projects.

Description	Schedule Influence	Typical Duration
Step I: Problem/Need/Opportunity Identification The proponent completes a Project Need Form (PNF). This form is then reviewed by the MassDOT District office, which provides guidance to the proponent on the subsequent steps of the process.	The PNF has been developed so that it can be prepared quickly by the proponent, including any supporting data that is readily available. The District office shall return comments to the proponent within one month of PNF submission.	1 to 3 months
Step II: Planning Project planning can range from agreement that the problem should be addressed through a clear solution to a more-detailed analysis of alternatives and their impacts.	For some projects, no planning beyond preparation of the Project Need Form is required. While other projects require a planning study centered on specific project issues associated with the proposed solution or a narrow family of alternatives. More complex projects will likely require a detailed alternatives analysis.	Project Planning Report: 3 to 24+ months
Step III: Project Initiation The proponent prepares and submits a Project Initiation Form (PIF) and a Transportation Evaluation Criteria (TEC) form in this step. The PIF and TEC are informally reviewed by the Metropolitan Planning Organization (MPO) and MassDOT District office, and formally reviewed by the Project Review Committee (PRC).	The PIF includes refinement of the preliminary information contained in the PNF. Additional information summarizing the results of the planning process, such as the Project Planning Report, is included with the PIF and TEC. The schedule is determined by PRC staff review (dependent on project complexity) and meeting schedule.	1 to 4 months

Step IV: Design, Environmental, and Right of Way The proponent completes the project design. Concurrently, the proponent completes necessary environmental permitting analyses and files applications for permits. Any right of way needed for the project is identified and the acquisition process begins.	The schedule for this step is dependent upon the size of the project and the complexity of the design, permitting, and right-of-way issues. Design review by the MassDOT District and appropriate sections is completed in this step.	3 to 48+ months
Step V: Programming The MPO considers the project in terms of its regional priorities and determines whether or not to include the project in its Draft Transportation Improvement Program (TIP) which is then made available for public comment. The TIP includes a project description and funding source.	The schedule for this step is subject to each MPO's programming cycle and meeting schedule. It is also possible that the MPO will not include a project in its Draft TIP based on its review and approval procedures.	3 to 12+ months
Step VI: Procurement The project is advertised for construction and a contract awarded.	Administration of competing projects can influence the advertising schedule.	1 to 12 months
Step VII: Construction The construction process is initiated including public notification and any anticipated public involvement. Construction continues to project completion.	The duration for this step is entirely dependent upon project complexity and phasing.	3 to 60+ months
Step VIII: Project Assessment The construction period is complete and project elements and processes are evaluated on a voluntary basis.	The duration for this step is dependent upon the proponent's approach to this step and any follow-up required.	1 month